The infant and family experience in neonatal intensive care: management of acute procedural pain
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Disclosure
Roger F. Soll, M.D. is the Vice President of the Vermont Oxford Network and the Coordinating Editor of Cochrane Neonatal.

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The infant and family experience in neonatal intensive care

Evidence synthesis for informed decisions and better health including:

1. Management of acute procedural pain;
2. Management of longer-term pain and discomfort associated with mechanical ventilation and surgical procedures; and
3. Impact of the intensive care environment and developmental care practices on infant development.
Stress in Neonatal Intensive Care

- Although there have been significant strides towards decreasing mortality in preterm infants, many surviving infants experience significant developmental problems, in both motor and intellectual development [Horbar 2012; Stoll 2015; Saigal 2008; Hintz 2011; Santos 2015].

- The stressful environment of neonatal intensive care is a double-edged sword, contributing to both improved survival as well as concerning developmental outcome.

Pain and discomfort

Painful procedures are a perfect example of the stress inflicted on newborn infants while receiving intensive care [Anand 2006].

A study in 2003 found that newborns in intensive care receive an unbelievable 14 painful procedures per day, while almost 40% did not receive any analgesic therapy [Simmons 2003].

Pain and discomfort

In response to such studies, the Committee on Fetus and Newborn of the American Academy of Pediatrics states that preventing or minimizing pain in neonates should be a priority for neonatal caregivers and recommends “written guidelines, based on existing and emerging evidence, for a stepwise pain-prevention and treatment plan” which would include judicious use of procedures, routine assessment of pain, and use of both pharmacologic and nonpharmacologic therapies for the prevention of pain.

The pain management strategy suggested by the Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicines is comprehensive, but acting on each facet is not without challenges. [Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicines 2016].

Surveys of practice

A variety of surveys from the early 2000s have demonstrated major gaps in staff knowledge and understanding to the diagnosis, implications and treatment of pain in neonates:

- Staff underestimated the pain caused by procedures.
- Pain assessment tools were used by a minority of centers.
- Respondents reported that analgesia and comfort measures were not usually administered for most procedures.
- Non-nutritive sucking was used by 66% of respondents but other methods of non-pharmacological management were under-utilized.
- Few (21% and 37%) had received training on neonatal pain.

Epidemiology and neonatal pain management of heelsticks in intensive care units: EPIPPAIN 2

Objectives: To describe the frequency of heelsticks and their analgesic management in newborns in the NICU. To determine the factors associated with the lack of specific preprocedural analgesia for this procedure.

Setting: All 16 NICUs in the Paris region in France.

Participants: All newborns in the NICU with a maximum corrected age of 44 weeks +6 days of gestation on admission who had at least one heelstick during the study period were eligible for the study. The study included 562 newborns.

Methods: Data on all heelsticks and their corresponding analgesic therapies were prospectively collected. The inclusion period lasted six weeks, from June 2, 2011 to July 12, 2011. Newborns were followed from their admission to the 14th day of their NICU stay or discharge, whichever occurred first.

Results:

The mean (SD; range) of heelsticks per neonate was 16.0 (14.4; 1-86) during the study period.

Of the 8995 heelsticks studied, 2379 (26.4%) were performed with continuous analgesia, 5236 (58.2%) with specific preprocedural analgesia.

Overall, 6764 (75.2%) heelsticks were performed with analgesia (continuous and/or specific).

What are the downstream effects of pain in hospitalized neonates?

It is no longer debated that premature infants have the necessary peripheral and central anatomical architecture required for nociceptive transmission.

Management of acute procedural pain

The prevention and alleviation of pain in neonates, particularly preterm infants, is important not only because it is ethical but also because 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, somatosensory, and stress response systems, which can persist into childhood. (e.g., reduced white matter microstructure and subcortical gray matter, dorsal horn central desensitization).

Minimizing procedures: POKE

POKE was developed and implemented at Dixie Regional Medical Center’s Neonatal Intensive Care Unit (NICU) over the past 10 years to eliminate waste and reduce harm in healthcare.

POKE is a combination of a unique culture and process, with a supporting database, that is designed to guide and inform care decisions while minimizing POKEs. The program utilizes an implementation framework, educational materials, electronic health records (EHR), and decision support analytics.

POKE’s initial deployment showed extremely promising results for Intermountain, which included: (1) eliminating 11,000 POKEs per year (a 50% reduction in overall POKEs), (2) realizing $940,000 per year in cost savings (a 28% reduction of overall cost), (3) reducing length of stay by 2 weeks per average stay (a 21% reduction in length of stay), and (4) eliminating Hospital Acquired Infections (i.e., Central-line Associated Bloodstream Infection and Ventilator-associated Pneumonia), translating into 10 lives saved and a $5.2M savings over a decade.
Routine assessment of pain

What our babies can’t tell us!

Optimal pain management requires competent pain assessment, which can be especially difficult to perform in neonates. The pain-assessment tool used should be multidimensional, including measurements for both physiologic and behavioral indicators of pain, because neonates cannot self-report.


Routine assessment of pain

Physiologic indicators of pain include changes in:

- heart rate
- respiratory rate
- blood pressure
- oxygen saturation
- vagal tone
- palmar sweating
- plasma cortisol or catecholamine concentrations

Behavioral indicators of pain may include changes in:

- facial expressions
- body movements
- crying

NB: may be absent in some neonates who are neurologically impaired or pharmacologically paralyzed.

2. Commonly used Neonatal Pain Assessment Scales

Routine assessment of pain

Facial expressions

Facial movements

Contraction of eyelids

Tense face


Routine assessment of pain

Optimal management for procedural pain

1. Venipuncture versus heel lance for blood sampling in term neonates
2. Breastfeeding or breast milk for procedural pain in newborn infants
3. Non-pharmacological management of infant and young child procedural pain
   - Non-nutritive sucking for procedural pain in newborn infants
   - Swaddling or tucking
4. Skin-to-skin care for procedural pain in neonates
5. Sweet solutions for procedural pain in newborn infants
6. Topical anesthesia for procedural pain in newborn infants
7. Non-opioid analgesic agents for procedural pain in newborn infants
8. Opioids for procedural pain in neonates

Venipuncture versus heel lance for blood sampling in term neonates

Shah VS, Ohlsson A.

Cochrane Database of Systematic Reviews 2011, Issue 10. Art. No.: CD001452.
DOI: 10.1002/14651858.CD001452.pub4.

Venipuncture versus heel lance for blood sampling in term neonates

**Background:**

Heel lance has been the conventional method of blood sampling in neonates for screening tests. Neonates undergoing heel lance experience pain which cannot be completely alleviated.

**Objectives:**

To determine whether venipuncture or heel lance is less painful and more effective for blood sampling in term neonates.

**Selection criteria:**

Trials comparing pain response to venipuncture versus heel lance with or without the use of a sweet tasting solution as a co-intervention in term neonates.

6 trials involving 478 infants

<table>
<thead>
<tr>
<th>Intervention/outcome</th>
<th>Studies</th>
<th>Infants</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Pain response to venipuncture versus heel lance in infants who did not receive a sweet tasting solution:</td>
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<tr>
<td>Neonatal Infant Pain Scale (NIPS) 2 studies 81 infants SMD -0.93 lower (95% CI -1.40 lower to -0.47 lower)</td>
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<tr>
<td>NFCS score 2 studies 147 infants SMD -0.71 lower (95% CI -1.05 lower to -0.38 lower)</td>
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<tr>
<td>PIP score 1 study 60 infants SMD -0.67 lower (95% CI -1.19 lower to -0.15 lower)</td>
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<tr>
<td>Overall estimate 5 studies SMD -0.76 lower (95% CI -1.00 lower to -0.52 lower)</td>
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<tr>
<td>Pain response to venipuncture versus heel lance in infants who received a sweet tasting solution</td>
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<tr>
<td>Neonatal Infant Pain Scale (NIPS) Not reported</td>
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<tr>
<td>NFCS score 2 studies 110 infants MD -0.48 lower (95% CI -0.87 lower to -0.09 lower)</td>
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<tr>
<td>PIP score 1 study 60 infants MD -0.21 lower (95% CI -0.72 lower to 0.30 higher)</td>
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<tr>
<td>Overall estimate 3 studies 230 infants MD -0.38 lower (95% CI -0.69 lower to -0.07 lower)</td>
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</table>

**Behavioral pain scores**

- **Need for more than one skin puncture**

  The RR for requiring more than one skin puncture for venipuncture versus heel lance is 0.29 (95% CI 0.18 to 0.46).

  The RD for requiring more than one skin puncture for venipuncture versus heel lance (reported in 4 studies; n = 254) was -0.34 (95% CI -0.43 to -0.25; I² = 97%). The NNT to avoid one repeat skin puncture was 3 (95% CI 2 to 4).

**Authors’ conclusions**

Venipuncture, when performed by a skilled phlebotomist, appears to be the method of choice for blood sampling in term neonates. The use of a sweet tasting solution further reduces the pain.

Further well designed randomized controlled trials should be conducted in settings where several individuals perform the procedures.
Breastfeeding or breast milk for procedural pain in newborn infants


**Background:** Pain in the neonate is associated with acute behavioral and physiological changes. Cumulative pain is associated with morbidities including adverse neurodevelopmental outcomes. Clinical studies have shown reduction in changes in physiological parameters and pain score measurements following pre-emptive analgesic administration in situations where the neonate is experiencing pain or stress. Non-pharmacological measures (such as holding, swaddling and breastfeeding) and pharmacological measures (such as acetaminophen, sucrose and opioids) have been used for analgesia.

**Objectives:** The primary objective was to evaluate the effectiveness of breastfeeding or supplemental breast milk in reducing procedural pain in neonates. The secondary objective was to conduct subgroup analysis based on the type of control intervention, gestational age and the amount of supplemental breast milk given.

**Selection criteria:** We included randomized controlled trials (RCTs) or quasi-RCTs of breastfeeding or supplemental breast milk versus no treatment/placebo or non-pharmacological interventions in neonates. We included both term (≥ 37 completed weeks postmenstrual age) and preterm infants (< 37 completed weeks' postmenstrual age) up to maximum of 44 weeks' postmenstrual age.

**Authors’ conclusions**

Moderate/low certainty of evidence suggest that breastfeeding or supplemental breast milk likely reduce pain in neonates undergoing painful procedure as compared to no intervention/positioning/holding neonates or placebo or non-pharmacological interventions.

Low certainty of evidence suggest that moderate concentration (20% to 33%) of glucose/sucrose may have little or no difference in reducing pain compared to breastfeeding.

The effectiveness of breast milk for painful procedure should be studied in the preterm population, as there are currently a limited number of studies that have assessed its effectiveness in this population.

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Breastfeeding or breast milk for procedural pain in newborn infants

**Intervention/outcome** | **Studies** | **Infants** | **Results**
--- | --- | --- | ---
Breastfeeding versus no intervention
- Heart rate | 2 studies | 303 infants | MD -0.56 bpm lower (95% CI -1.84 lower to 0.72 higher)
- Duration of crying | 10 studies | 760 infants | MD -20.23 seconds lower (95% CI -30.57 lower to -9.86 lower)
- Neonatal Infant Pain Scale (NIPS) | 5 studies | 459 infants | MD -2.53 lower (95% CI -3.96 lower to -1.06 lower)

Breastfeeding versus being held by mother
- Heart rate | 5 studies | 295 infants | MD -11.78 bpm lower (95% CI -19.95 lower to -3.60 lower)
- Duration of crying | 4 studies | 260 infants | MD -16.50 seconds lower (95% CI -29.68 lower to -3.32 lower)
- Neonatal Infant Pain Scale (NIPS) | 3 studies | 230 infants | MD -0.81 lower (95% CI -1.57 lower to -0.05 lower)

Breast milk feeding versus no intervention
- Heart rate | 1 study | 60 infants | MD -20.00 bpm lower (95% CI -28.74 lower to -11.26 lower)
- Duration of crying | 1 study | 60 infants | MD 36.70 seconds higher (95% CI 0.60 higher to 72.80 higher)
- Oxygen saturation | 2 studies | 166 infants | MD -0.90 seconds lower (95% CI -1.40 lower to -0.40 lower)
- Neonatal Infant Pain Scale (NIPS) | 1 study | 60 infants | MD -0.30 lower (95% CI -1.60 lower to 1.00 higher)

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Breastfeeding or breast milk for procedural pain in newborn infants

**Non-pharmacological management of infant and young child procedural pain.**

Non-nutritive sucking

What do we mean by “Non-nutritive sucking”

Non-nutritive sucking-related strategies: an object (e.g. pacifier, non-lactating nipple) is placed into an infant’s mouth to stimulate oro-tactile or sucking behaviors during a painful event.

This may have involved other adjuvant non-pharmacological interventions that fall under the purvey of the review.

Outcome Studies Infants Results

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Studies</th>
<th>Infants</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain reactivity</td>
<td>6 studies (7 arms)</td>
<td>329 infants</td>
<td>SMD -0.31 lower (95% CI -0.65 lower to 0.04 higher)</td>
</tr>
<tr>
<td>Immediate pain regulation</td>
<td>5 studies (7 arms)</td>
<td>260 infants</td>
<td>SMD -0.43 lower (95% CI -0.63 lower to -0.23 lower)</td>
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Term infants

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Studies</th>
<th>Infants</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain reactivity</td>
<td>5 studies</td>
<td>270 infants</td>
<td>SMD -1.20 lower (95% CI -2.01 lower to -0.38 lower)</td>
</tr>
<tr>
<td>Immediate pain regulation</td>
<td>7 studies</td>
<td>325 infants</td>
<td>SMD -0.99 lower (95% CI -1.54 lower to -0.25 lower)</td>
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Very low quality evidence

Swaddling/facilitated tucking

What do we mean by “swaddling/facilitated tucking”

Swaddling is when an infant is securely wrapped in a blanket to prevent the child’s limbs from moving around excessively.

Facilitated tucking involves firmly containing the infant using a caregiver’s hands on both head and lower limbs to maintain a ‘folded-in’ position. Infant may or may not be wearing clothes.

Outcome Studies Infants Results

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Studies</th>
<th>Infants</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain reactivity</td>
<td>9 studies</td>
<td>331 infants</td>
<td>SMD -0.89 lower (95% CI -1.37 lower to -0.40 lower)</td>
</tr>
<tr>
<td>Immediate pain regulation</td>
<td>5 studies</td>
<td>119 infants</td>
<td>SMD -0.71 lower (95% CI -1.00 lower to -0.43 lower)</td>
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Term infants

<table>
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<tr>
<th>Outcome</th>
<th>Studies</th>
<th>Infants</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td>Pain reactivity</td>
<td>1 study</td>
<td>42 infants</td>
<td>SMD -1.26 lower (95% CI -1.92 lower to -0.60 lower)</td>
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</table>
Skin-to-skin care for procedural pain in neonates


Background: Skin-to-skin care (SSC), often referred to as ‘kangaroo care’ (KC) due to its similarity with marsupial behavior of ventral maternal-infant contact, is one non-pharmacological intervention for pain control in infants.

Objectives: The primary objectives were to determine the effect of SSC alone on pain from medical or nursing procedures in neonates compared to no intervention, sucrose or other analgesics, or additions to simple SSC such as rocking; and to determine the effects of the amount of SSC (duration in minutes), method of administration (e.g. who provided the SSC) of SSC in reducing pain from medical or nursing procedures in neonates.

The secondary objectives were to determine the safety of SSC care for relieving procedural pain in infants; and to compare the SSC effect in different postmenstrual age subgroups of infants.

Selection criteria: Studies with randomization or quasi-randomization, double- or single-blinded, involving term infants (≥ 37 completed weeks’ postmenstrual age (PMA) to a maximum of 44 weeks’ PMA) and preterm infants (< 37 completed weeks’ PMA) receiving SSC for painful procedures conducted by healthcare professionals.

Intervention/outcome Studies Infants Results

- Heart rate during
  - 5 studies 161 infants MD -10.78 bpm lower (95% CI -13.63 lower to -7.93 lower)
  - 4 studies 120 infants MD 0.08 seconds higher (95% CI -4.39 lower to 4.55 higher)

- Duration of crying
  - 2 studies heel lance 33 infants MD -34.16 seconds lower (95% CI -42.86 lower to -25.45 lower)
  - 2 studies IM injection 100 infants MD −8.83 seconds lower (95% CI −14.63 lower to −3.02 lower)

- Premature Infant Pain Profile (PIPP)
  - 3 studies 60 seconds 307 infants MD −3.21 lower (95% CI −3.94 lower to −2.47 lower)
  - 3 studies 90 seconds 307 infants MD −1.64 lower (95% CI −2.86 lower to −0.43 lower)
  - 3 studies 120 seconds 307 infants MD −0.83 seconds lower (95% CI −1.43 lower to −0.23 lower)

Authors’ conclusions

SSC appears to be effective as measured by composite pain indicators with both physiological and behavioral indicators and, independently, using heart rate and crying time, and safe for a single painful procedure.

There is a need for replication studies that use similar, clearly defined outcomes. Studies examining optimal duration of SSC, gestational age groups, repeated use, and long-term effects of SSC are needed. Of interest would be to study synergistic effects of SSC with other interventions.

Sucrose for analgesia in newborn infants undergoing painful procedures.

Stevens B, Yamada J, Ohlsson A, Haliburton S, Shorkey A.

Administration of oral sucrose with or without non-nutritive sucking is the most frequently studied non-pharmacological intervention for procedural pain relief in neonates.

Intervention/outcome | Studies | Infants | Results
---|---|---|---
Heel lance: sucrose (12% to 12.5%) versus water/routine care | 1 study | 42 infants | MD -48.09 seconds lower (95% CI -93.04 lower to -3.14 lower)
Heel lance: sucrose (20% to 33%) versus water | 2 studies | 88 infants | MD -22.11 seconds lower (95% CI -32.52 lower to -11.70 lower)
Heel lance: sucrose (50%) versus water | 2 studies | 80 infants | MD -63.20 seconds lower (95% CI -79.20 lower to -47.19 lower)
Heel lance: sucrose (20%) versus human milk | 1 study | 35 infants | MD -8.00 seconds lower (95% CI -21.07 lower to 5.07 higher)
The review included 8 small randomized controlled trials enrolling 506 infants. These studies compared either EMLA and placebo or amethocaine and placebo. No studies compared EMLA and amethocaine. We were unable to meta-analyze the outcome of pain due to differing outcome measures and methods of reporting.

For EMLA, two individual studies reported a statistically significant reduction in pain compared to placebo during lumbar puncture and venipuncture. Three studies found no statistical difference between the groups during heel lancing.

For amethocaine, three studies reported a statistically significant reduction in pain compared to placebo during venipuncture and one study reported a statistically significant reduction in pain compared to placebo during cannulation. One study reported no statistical difference between the two groups during intramuscular injection.

### Authors’ conclusions

Overall, all the trials were small, and the effects of uncertain clinical significance. The evidence regarding the effectiveness or safety of the interventions studied is inadequate to support clinical recommendations. There has been no evaluation regarding any long-term effects of topical anesthetics in newborn infants. High quality studies evaluating the efficacy and safety of topical anesthetics such as amethocaine and EMLA for needle-related pain in newborn term or preterm infants are required. These studies should aim to determine efficacy of these topical anesthetics and on homogenous groups of infants for gestational age.

While there was no methemoglobinemia in the studies that reported methemoglobin, the efficacy and safety of EMLA, especially in very preterm infants, and for repeated application, need to be further evaluated in future studies.

#### Non-opioid analgesics for procedural pain in neonates

Persad E, Pizarro AB, Bruschettini M.

### Background

A wide variety of pain control mechanisms have been developed and implemented to address procedural pain in neonates. This review focused on non-opioid analgesics, specifically nonsteroidal anti-inflammatory drugs (NSAIDs) and N-methyl-D-aspartate (NMDA) receptor antagonists, which alleviate pain through inhibiting cellular pathways to achieve analgesia.

### Objectives

To determine the effects of non-opioid analgesics in neonates (term or preterm) exposed to procedural pain compared to placebo or no drug, non-pharmacological intervention, other analgesics, or different routes of administration.
Non-opioid analgesics for procedural pain in neonates


2 trials
269 infants

Authors' conclusions
The two small studies included (ketamine versus either placebo or fentanyl) with very low-certainty evidence rendered us unable to draw meaningful conclusions.

The evidence is very uncertain about the effect of ketamine on pain score during the procedure compared with placebo or fentanyl. No evidence was found on NSAIDs or studies comparing different routes of administration.

Future research should prioritize large studies evaluating non-opioid analgesics in this population. As the studies included in this review suggest potential positive effects of ketamine administration, studies evaluating ketamine are of interest.

Further, as no studies on NSAIDs, which are widely used in older infants, or comparing different routes of administration were identified, these should be a priority going forward.

Non-opioid analgesics for procedural pain


Opioids for procedural pain in neonates.


Background:
Neonates might be exposed to numerous painful procedures due to diagnostic reasons, therapeutic interventions, or surgical procedures.

Options for pain management include opioids, non-pharmacological interventions, and other drugs. Morphine, fentanyl, and remifentanil are the opioids most often used in neonates. However, negative impact of opioids on the structure and function of the developing brain has been reported.

Objectives:
To evaluate the benefits and harms of opioids in term or preterm neonates exposed to procedural pain, compared to placebo or no drug, non-pharmacological intervention, other analgesics or sedatives, other opioids, or the same opioid administered by a different route.

13 trials
823 infants

Opioids for procedural pain in neonates

Conclusions
Limited evidence is available regarding opioid administration for procedural pain in new-born infants compared to placebo or no drug, non-pharmacological interventions, other opioids or analgesics, or the same opioid by different route of administration.

In comparison to placebo, opioids probably reduce pain score assessed shortly after the procedure.

The evidence is very uncertain about the effect of opioids on episodes of bradycardia or hypotension. Opioids may result in a large increase in episodes of apnea.

No studies reported parent satisfaction with care provided in the NICU.

The evidence is very uncertain about the effect of opioids on any outcome when compared to non-pharmacological interventions or to other analgesics.


Questions regarding minimizing procedural pain…

Where does the evidence take us?

What are best “practices” regarding minimizing procedural pain?

What future research is urgently needed?
The infant and family experience in neonatal intensive care: management of acute procedural pain

To develop an understanding of the strengths and weaknesses of evidence provided by systematic reviews and meta-analyses to inform our practice of neonatal-perinatal medicine.

Today’s focus will be on managing acute procedural pain.
How to Participate in Today’s Webinar

• Type questions you have into the chat box at anytime during the presentation.

• Use Poll Everywhere to answer questions posed during the session.

Three ways to use Poll Everywhere

• Open your web browser and type in pollev.com/vtoxford

• Download the app Poll Everywhere on your phone. After it is installed open and select Join Presentation and type in vtoxford

• Text vtoxford to 22333

Did you make any New Year’s resolutions this year?

- Yes 33%
- No 59%
- I can’t remember 1%
- I did but have already broken them 4%

Management of acute procedural pain

• Impact of pain on neonates
• Guidelines for pain management
• Policies and procedures to minimize painful procedures
• Assessment of pain
• Treatment(s) for procedural pain
The prevention and alleviation of pain in neonates, particularly preterm infants, is important not only because it is ethical but also because exposure to repeated painful stimuli early in life is known to have short- and long-term adverse sequelae.

<table>
<thead>
<tr>
<th>True</th>
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Impact of pain in neonates

- Physiologic instability
- Altered brain development
- Abnormal neurodevelopment, somatosensory, and stress response systems, which can persist into childhood. (e.g., reduced white matter microstructure and subcortical gray matter, dorsal horn central desensitization)

Our unit has policies and guidelines in place to minimize painful procedures:

<table>
<thead>
<tr>
<th>Yes</th>
<th>65%</th>
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<tr>
<td>No</td>
<td>26%</td>
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<tr>
<td>Uncertain</td>
<td>8%</td>
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Policies and guidelines to minimize painful procedures

Erick Ridout
Neonatologist/Medical Director
Neonatology Department
Saint George Regional Hospital

Minimizing procedures:

- 50% reduction in POKEs (11,000/yr)
- Reduction in length of stay (~248 hours)
- CLABSI (1/15 years) Last 4211 days ago
- Press Ganey Engagement: 4.64
- RN Turnover <3%

Minimizing procedures: Multi-Hospital Deployment of POKE (1 year):

- 150,000 POKEs eliminated
- POKEs per patient: 5.1/day -> 3.1/day
- $1.2 Million Cost Avoided
- $50 Million Net Revenue Decrease

Minimizing procedures:

- 50% reduction in POKEs (11,000/yr)
- Reduction in length of stay (~248 hours)
- CLABSI (1/15 years) Last 4211 days ago
- Press Ganey Engagement: 4.64
- RN Turnover <3%

Just Culture

Guest Discussants
Obtaining blood for laboratory assessment or screening tests

To obtain blood for routine laboratory tests we typically use:

- Venipuncture: 8%
- Heelstick: 91%
- Uncertain: 1%


Pain response to Venipuncture versus heel lance in infants who did not receive a sweet tasting solution:

- Behavioral pain scores: (SMD -0.76, 95% CI -1.00 to -0.52; I² = 0%).

Assessment of pain

Our unit has policies and guidelines in place that address the assessment of pain:

- Yes: 92%
- No: 5%
- Uncertain: 3%

Optimal pain management requires competent pain assessment, which can be especially difficult to perform in neonates.

The pain-assessment tool used should be multidimensional, including measurements for both physiologic and behavioral indicators of pain, because neonates cannot self-report.


Routine assessment of pain

We primarily use the following pain scales in our assessment of pain:

- Neonatal Facial Coding System (NFCS-R): 1%
- Premature Infant Pain Profile Revised (PIPP-R): 10%
- Neonatal Infant Pain Scale Revised (NIPS-R): 6%
- Neonatal Pain, Agitation and Sedation Scale (N-PASS): 19%
- Other scales/scores: 6%
- No pain scales/scores in routine use: 0%

Tool Characteristics Score Reliability

- Neonatal Facial Coding System Revised (NFCS-R):
  - Test-retest of inter-rater reliability: 0.5
  - High inter-rater and construct validity

- Premature Infant Pain Profile Revised (PIPP-R):
  - The physiological, three behavioral indicators: 0-18
  - Moderate consistency

- Neonatal Pain, Agitation and Sedation Scale (N-PASS):
  - Five items: (1) crying; (2) behavior state; (3) facial expression; (4) tone of extremities; (5) vital sign changes (choice between HR, blood pressure, pulse, and oxygen saturation): 0-13 for preterm babies, 0-10 for term babies
  - High consistency
  - High validity
  - Treatment recommended with score >3

- Neonatal Infant Pain Scale (NIPS):
  - Six behavioral indicators: 0-7
  - High consistency
  - Limited validity data

- Bernese Neonatal Pain Scale (BNPS):
  - Three physiological and six behavioral indicators: 0-27
  - High consistency

Assessment of pain

We receive formal training in the use of pain scales in our assessment of pain.

- Yes: 59%
- No: 30%
- Uncertain: 3%

We do not have policies regarding the routine use of pain scales.

Treatments for procedural pain

Our unit has policies and guidelines in place that address treatment of procedural pain.

- Yes: 70%
- No: 25%
- Uncertain: 5%

Treatments for procedural pain

We use the following non-pharmacologic approaches to procedural pain:

- Non-nutritive sucking: 36%
- Swaddling/tucking: 12%
- Breastfeeding or breast milk: 3%
- Sucrose or other sweet-tasting solutions: 40%
- Topical anesthesia: 1%
- Other approaches: 1%
- Uncertain: 1%

Parents as partners

Our unit has policies and guidelines in place to communicate our approach to pain management and include parents in the assessment and alleviation of pain in their baby.

- Yes: 28%
- No: 73%
- Uncertain: 7%

Pain and discomfort

The Committee on Fetus and Newborn of the American Academy of Pediatrics states that preventing or minimizing pain in neonates should be a priority for neonatal caregivers and recommends "written guidelines, based on existing and emerging evidence, for a stepwise pain-prevention and treatment plan" which would include judicious use of procedures, routine assessment of pain, and use of both pharmacologic and nonpharmacologic therapies for the prevention of pain.

The pain management strategy suggested by the Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicines is comprehensive, but acting on each facet is not without challenges.

[Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicines 2016].

Pain and discomfort

Although there are major gaps in knowledge regarding the most effective way to prevent and relieve pain in neonates, proven and safe therapies are currently underused for routine minor, yet painful procedures.

Therefore, every health care facility caring for neonates should implement:

1. A pain-prevention program that includes strategies for minimizing the number of painful procedures performed, and
2. A pain assessment and management plan that includes routine assessment of pain, pharmacologic and nonpharmacologic therapies for the prevention of pain associated with routine minor procedures, and measures for minimizing pain associated with surgery and other major procedures.

[Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicines 2016].
Future programs for 2023:

Plans for safe care – NAS
Translating evidence to practice: The use of CPAP in diverse settings
Translating evidence to practice: Care of the developing brain