

NEONATAL PAIN MANAGEMENT

*Pediatric Pain
Resource Nurse
Curriculum*

 Ann & Robert H. Lurie
Children's Hospital of Chicago™

The
MAYDAY
Fund

Table of Contents

<i>page</i>	<i>page</i>	<i>page</i>	<i>page</i>	<i>page</i>
3	8	15	20	22
<i>Neonates and Pain</i>	<i>Pain Assessment Challenges</i>	<i>Neonatal Pain Management</i>	<i>In Summary</i>	<i>Appendix</i>

Objectives

- Explain the significance of fetal neurodevelopment on nociception in preterm and term neonates
- Describe the prevalence of pain in preterm and term neonates
- Identify pain assessment and management challenges in preterm and term neonates
- Explain the potential long term impact of poorly controlled neonatal pain and current pain management strategies used to treat pain experienced by preterm and term neonates

Neonates and Pain



- **What common sources of pain are experienced by neonates in hospitals?**
- **Of these, which are unique to babies in the NICU?**

Type your answer here.

Prevalence of pain in NICUs

Neuroanatomical consequences of preterm birth

- Decreased white matter volume and periventricular leukomalacia
- Decreased cortical gray and deep gray matter
- Smaller corpus callosal areas
- Ventricular hypertrophy

9% of newborns admitted to NICUs (Walker, 2013) ~ **400,000 US** (CDC, 2016) ~ **15 million** (WHO, 2016)



54 infants
(Barker & Rutter, 1995)
>3000 procedures
74% in < 31 weekers
One 23 weeker had 488 procedures

Randomized cross over
(Stevens, et al, 2001)
27-31 weekers
Average number of procedures was 134
SD 144, Range 0-821
10% of the youngest & sickest had >300 procedures

430 neonates
(Carbajal et al, 2008)
2 week period
42,413 painful first attempt procedures
Each neonate:
Median of 115 procedures during study
16 per day per day of hospitalization
21% received analgesia prior to painful procedures
34% received ongoing analgesia

Fetal Neurodevelopment

Nociceptive pathways functional as early as 25 weeks

- Incomplete myelination
- Shorter nerve fibers
- Larger cutaneous receptor fields



Sensory/Perception

- Altered balance between excitatory and inhibitory feedback mechanisms
- Poor localization and discrimination
- Poor noxious inhibitory modulation
- CNS sensitization
- Greater prematurity = greater pain

Consequences of poorly controlled pain in neonates



Neurophysiology

- Increased blood flow in somatosensory cortex
- Changes in EEG activity
- Cortical response to peripheral stimuli
- Reduced white matter and subcortical gray matter maturation
- Absence of endogenous pain inhibition
- Toxic stress

Social/Family Factors

- Lower parenting stress may buffer effects of pain (Grunau et al., 2009)
- Decreased total gray and white matter volumes, increased amygdala volumes in children with reduced parental care

Developmental/Cognitive/Motor

- Lower scores on motor and psychomotor indices with greater exposure to morphine
- Degree of white matter damage at term is predictive of neurocognitive outcome at 4-6 years of age
- Smaller brain volume, increased white matter damage resulting in impaired neurodevelopment seen in former preterms who required surgery
- Neuro re-modeling
- Growth impairment
- Large number of painful procedures before 32 weeks PCA

Pain Assessment Challenges



**How is pain commonly
assessed in neonates?**

Type your answer here.

Hierarchy of Assessments for Children unable to Self-Report



Methods of assessing pain in children unable to self-report should follow this hierarchy. Anticipate and treat pain.

- Anticipate and treat pain caused by procedures.
- Review the patient's clinical condition. Are there any problems or diagnoses that commonly cause pain? If so, assume pain is present and treat it.
- Rule out other conditions such as constipation or infection. Be sure the patient is dry, warm, or cool enough, positioned in a comfortable way, and that other basic needs are met.
- Be vigilant for subtle behavioral changes. ***Remember that behavioral changes do not translate to a pain intensity rating, but should raise suspicion of the presence of pain.***
- Ask others (surrogate reporting), if the child is in pain. Those who know a patient best can help identify specific behaviors that indicate pain for this individual.
- If pain is likely, attempt an analgesic trial and look for changes in behavior or other signs of improvement.

Herr, Coyne, Ely & Manworren (accepted for publication 2019) Pain Assessment in the Patient Unable to Self- Report: Position Statement with Clinical Practice Recommendations.

Herr, Coyne, McCaffery, Key, Manworren & Merkel. (2011). Pain assessment in the patient unable to self-report: Position statement with clinical practice recommendations. *Pain Management Nursing* 12 (4), 230-250.

Physiologic Measures



It is important to note that vital signs and physiologic measures are not included in the hierarchy of pain assessment measures.

Physiologic Responses

- Neonates clearly display metabolic, hormonal, and physiological responses to pain
- Physiological changes should be recognized as lacking specificity for pain, since these respond to exertion, fever, anxiety and other stresses, including disease processes.
- Physiologic changes are neither specific nor sensitive to pain

Physiological responses to pain indicate the activation of the sympathetic nervous system, which is part of the autonomic nervous system, and is responsible for the fight or flight response associated with stress.

These physiological changes should be recognized as:

- reflecting stress reactions;
- occurring in response to other states such as exertion, fever, and anxiety.

On their own, physiological indicators do not constitute a valid clinical pain measure for children.

A multidimensional or composite tool incorporates physiological and behavioral indicators of distress.

Behavioral Measures



Over 60 observational tools have been developed to assess children's pain from birth through adolescence. These tools generally rely on observations of behaviors associated with pain.

Of all behaviors associated with pain, withdrawal reflex and facial expressions are the only ones that have been associated with brain-based evidence of pain.

Commonly identified behaviors indicative of pain in infants are:

- Individual behaviors (facial expression and crying)
- Large movements (withdrawal of the affected limb and movement or tensing of limbs and torso)
- Changes in sleep/wake state or cognitive functions

Challenges with Observational measures include:

- Difficulty observing the behavior due to medical equipment or restraints (for example, tape on face, intubation, arm boards, or sedatives and chemical neuromuscular agents)
- Loss of behavioral response with adaption and persistence of pain
- No way to distinguish pain behaviors from other kinds of distress behaviors.

Multidimensional Pain Tools for Neonates

There are over a dozen multidimensional observational pain tools that have been validated for acute and procedural pain in neonates and neonates requiring mechanical ventilation. Here are some examples

Tool	Components	Considerations
NIPS: Neonatal Infant Pain Scale <i>Lawrence, et al., 1993; Ge, et al., 2015; Desai, et al., 2018</i>	Sum of facial actions, breathing, arms, legs, and level of arousal scored as 0 or 1, and cry scored 0, 1 or 2 for a total observation score of 0-7.	<ul style="list-style-type: none"> • Neonates and infants up to 12 months • Acute and procedural pain
PIPP: Premature Infant Pain Profile and PIPP-revised <i>Stevens et al., 1996; Stevens, et al., 2010; Stevens et al., 2014; Desai, et al., 2017</i>	Sum of facial actions, such as brow bulge, eyes squeeze, and nasolabial furrow, heart rate and oxygen saturation, in the context of gestational age and behavioral state for total observation score from 0-21.	<ul style="list-style-type: none"> • Premature and full-term neonates infants up to 12 months • Acute post-operative and procedural pain
NPASS: Neonatal Pain, Agitation and Sedation Scale <i>Hummel, et al., 2008; Hummel, Lawlor-Klean, & Weiss, 2010; Hummel, 2017; Desai, et al., 2017 & 2018</i>	Sum of facial expression, behaviors, extremity tone, cry, and vital signs in the context of gestational age for a total score from -2 to +2 for each	<ul style="list-style-type: none"> • Neonates 23-40 weeks gestation • Acute post-operative and procedural pain • Sedation • Validated for use during mechanical ventilation.
DSVNI: Distress Scale for Ventilated Newborn Infants <i>Sparshott, 1996</i>	Sum of 4 physiologic (heartrate, blood pressure, oxygen saturation, and temperature differential), and 3 behaviors (facial expressions and body movements).	<ul style="list-style-type: none"> • Neonates and Infants • Acute and procedural pain • Validated for use during mechanical ventilation.
COMFORT-neo <i>Ambuel, et al., (1992, van Dijk, et al, 2000, Maaskant, et al., 2016. .</i>	Sum of 8 parameters (alertness, calmness, respiratory distress, physical movement, muscle tone, facial tension, blood pressure, and heart rate) for a total observation score from 8-40. Also valid without physiologic parameters (COMFORT-B).	<ul style="list-style-type: none"> • Critically ill Neonates and Infants • Acute post-operative pain • Sedation • Distress

Jessica

What will a baby in pain look like? Will a lethargic baby behave in the same way when in pain?

How would you answer?

Jessica was born at 31 weeks gestational age. Now 15 days old, she is hospitalized in the neonatal intensive care unit for monitoring of prematurity.

Her vital signs are: heart rate 179, respiratory rate 60, blood pressure 50/32, oxygen saturation 88% and temperature 38.0°C axillary. She is also mildly lethargic.

The nurse suspects Jessica is septic and begins a septic workup. This includes a urinary culture and an intravenous blood draw for a complete blood count, electrolyte levels, and blood cultures. As the nurse is preparing for the venipuncture and urinary catheter insertion, Jessica's parents ask questions...

Neonatal Pain Management



- **What are unique risks of analgesics and anesthetics used to manage pain in neonates?**
- **Is sucrose pharmacologic or nonpharmacologic?**
- **What biobehavioral strategies are used to manage pain in neonates?**

Type your answer here.

Management



Pharmacological

- Acetaminophen
- Opioids
- Topical anesthetics
- Benzodiazepines
- Volatile anesthetics

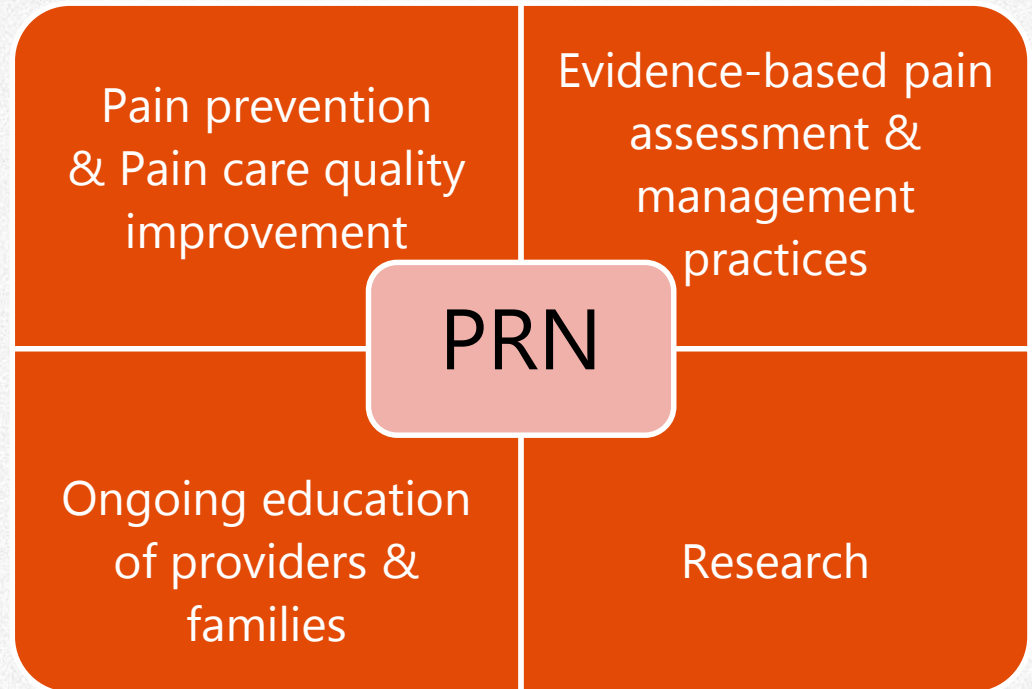
Other Medications

- Gabapentin
- Clonidine
- Dexmedetomidine
- Ketamine
- Propofol
- Others?

Biobehavioral (Non-Pharmacological or Non-Drug)

- Skin-Skincare (Kangaroo care)
- Breastfeeding
- Pacing and Bundling Care
- Managing the environment
- White noise
- Positioning
- Sucrose
- Glucose
- Massage
- Music
- Others?

Organizational Responsibilities





Take a minute to reflect...
We don't hurt babies
anymore, do we?
Why or why not?

Type your answer here.

**In
Summary...**

Key Points

Pain is too common in the neonatal period.

Pain has a negative impact on neonates.

Appropriate assessment tools exist for neonates.

We can safely and effectively manage pain in the neonatal period.

Pain management is a balancing act between benefit and harm.

Multimodal pain treatment options exist.

Healthcare organizations have an obligation to treat pain.



Appendix

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