

A Review Article on Pain in Neonates: Causes, Effects, Responses, Assessment, & Management

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Abstract

Neonates do not express the feeling of pain. So, they respond through only physiological, behavioral cues and hormonal or metabolic responses. The most common causes of pain in neonates are various minor procedures like heel sticks, venipunctures and so on. Hence, assessment and management of pain is very important for every health professionals who are working in NICU.

Keywords: Effects of Pain; Assessment of Pain; Management of Pain; Nicu; Behavioral Cues.

Introduction

Pain is an unpleasant sensory and emotional experience which is associated with actual or potential damage of tissues. So, pain is almost considered as a *fifth vital sign*. Unfortunately, neonates cannot verbalize their own pain experience and they have to depend on their caregivers to assess and manage it. Neonates admitted to the NICU may experience pain because of diagnostic or therapeutic interventions or as result of various illness. However, in both preterms and term neonates, pain system is intact and functional.

What causes pain to a neonate in NICU

- *Acute pain*: acute pain will last for short period of time and it results from various minor procedures like heel sticks, venipunctures, tracheal suctioning, lumbar puncture, circumcision.
- *Prolonged/chronic pain*: It causes from illness such as NEC, meningitis, birth trauma and from therapeutic procedures such as mechanical ventilation, Central line insertion and removal, chest tube insertion and removal, chest physiotherapy dressing change, gavage tube insertion, intramuscular injection, peripheral venous catheterization, tracheal intubation and extubation, tracheal suctioning.

- *Post-operative pain*: It causes from surgical interventions such as hernia repair, ligation of PDA, VP shunts, abscess drainage etc.
- *Routine care*: it occurs from daily routines like diaper change, daily weights, removing adhesive tapes, burns from transcutaneous probes and cold light, rectal stimulation.

Effects of pain

1. Immediate effects
2. Long term effect of untreated pain

Immediate Effects

- Reduced Tidal Volume (TV) and Vital Capacity (VC) in the lungs.
- Increased demands in the CVS.
- Hypermetabolism resulting in neuro-endocrine balances, increased oxygen consumption, hypoxemia, myocardial ischemia.
- Mobilization of endocrine and metabolic resources resulting in changes in blood pressure, changes in skin color and temperature.
- Prolonged catabolic reactions as well as circulatory and metabolic complications after surgery when anesthetic agents were not administered or were inadequate

Long Term Effects of Untreated Pain

- Alteration in cerebral neuro anatomy.
- Avoidance and alteration in response to stimuli.
- Developmental delays.
- CNS handicap.

Assessment of Pain

Pain assessment in neonates is not as same like adults. Interestingly, the character, location, duration and rhythm cannot be measured in neonates. So, pain assessment instrument should be sensitive and specific for neonates of all gestational ages and it should be contextual. Concomitantly with the vital signs, assessment of neonatal pain must be undertaken every 4-6 hours or as indicated by the clinical condition of the neonate. Pain assessment should be comprehensive and multidimensional, including behavioral and physiological indicators.

Pain scales

Pain scales in neonates are used to assess the acute procedural pain and post-operative pain. There are different types of pain scales available for neonates.

Table 1: Pain Scales

Sl. No	Name of the scale
1	PIPP-Premature Infant Pain Profile
2	NIPS-Neonatal Infant Pain Scale
3	CRIES score
4	The Pain Assessment Tool (PAT)
5	SUN Scale (Modified)
6	Neonatal Facial Coding System (NFCS)
7	N-PASS Scale (Neonatal Pain, Agitation & Sedation Scale)

PIPP scale (Premature Infant Pain Profile)

PIPP consists of seven indicators including assessment of gestational age and behavioral state (contextual indicators), heart rate and oxygen saturation (physiological indicators), and facial actions – brow bulge, eye squeeze, and nasolabial furrow (behavioral indicators) This scale can be used in neonates whose gestational week lies between 27th week and term gestation.

Minimum frequency of assessment:

- Intensive care: Within 1 hour of admission. Hourly with observations

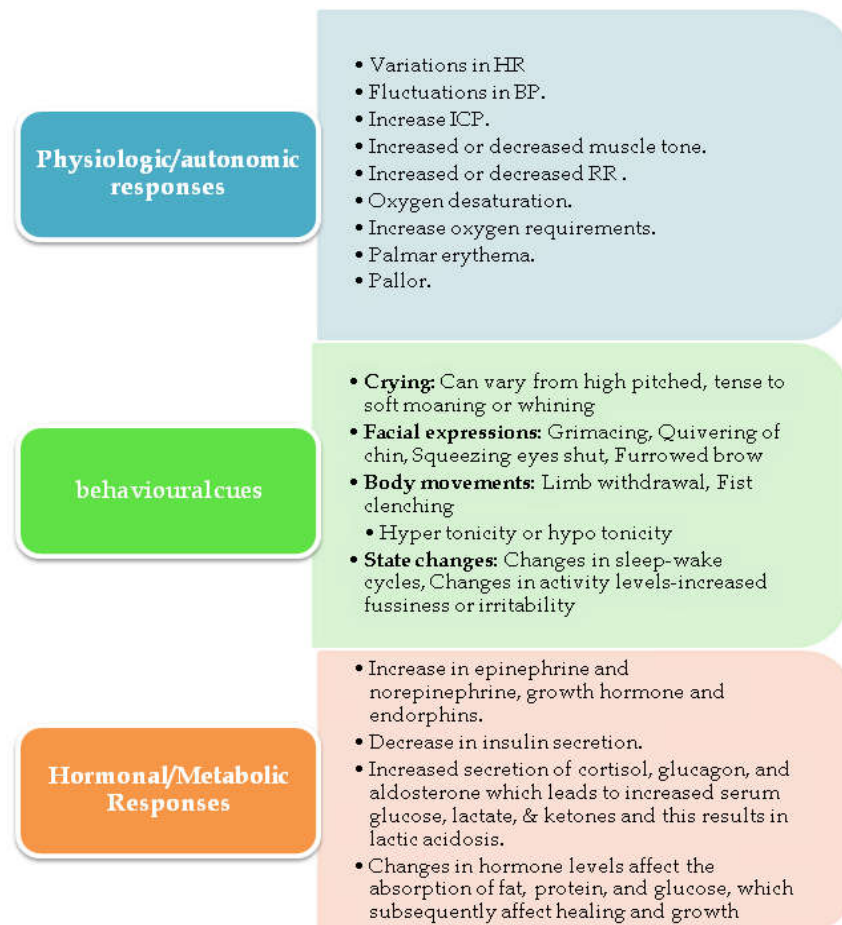


Chart 1: How the newborn responds to Pain

- High dependency: Within 1 hour of admission. 6-8 hourly (before cares) or if signs of distress /discomfort
- Special care: Within 1 hour of admission. If baby shows signs of distress/discomfort not associated with need for routine care giving
- Post-operatively: Hourly for first 8 hours. 4 hourly until 48 hours post-op.

NIPS Scale (Neonatal Infant Pain Scale)

The Neonatal Infant Pain Scale (NIPS) is a behavioral scale and can be utilized with both full-term and pre-term infants. It is composed of six (6) indicators such as facial expression, cry, breathing patterns, arms, legs and state of arousal

CRIES Score

CRIES is an observer-rated pain assessment tool which is performed by a healthcare practitioner

Table 2: PIPP Scale

Criteria	0	1	2	3
Gestational age	>/= 36wks	32-35wks	28-31wks	</=28wks
Behavioral state (observe for 15seconds)	Active/ awake	Quiet/awake	Active/ sleep	Quiet/sleep
Heart rate	0 bpm increase	5-15 bpm increase	15-24 bpm increase	>24 bpm increase
O2 saturation	0-2.4% decrease	2.5–4.9% decrease	5-7.4% decrease	7.5%or > decrease
Brow bulge	None	Minimum	Moderate	Maximum
Eye squeeze	None	Minimum	Moderate	Maximum
Nasolabial furrow	None	Minimum	Moderate	Maximum

Scoring

Score	Level of pain	Remarks
Score 0 - 6	Generally indicates the infant has minimal or no pain	No Action
Score 7-12	Generally indicates slight to moderate pain	Institute comfort measures
Score > 12	may indicate severe pain	Pharmacological Intervention

Table 3: NIPS Scale (Neonatal Infant Pain Scale)

NIPS	0 point	1 point	2 points
Facial expression	Relaxed	Contracted	-
Cry	Absent	Mumbling	Vigorous
Breathing	Relaxed	Different than basal	-
Arms	Relaxed	Flexed/ stretched	-
Legs	Relaxed	Flexed/ stretched	-
Alertness	Sleeping/ calm	Uncomfortable	-

Scoring

Score	Level of pain	Management
0-2	mild to no pain	None
3-4	mild to moderate pain	Non-pharmacological intervention with a reassessment in 30 minutes
>4	severe pain	Non-pharmacological intervention and possibly a pharmacological intervention with reassessment in 30 minutes

Table 4: CRIES Score

CRIES scale	0	1	2
Crying	No	High pitch consolable	Inconsolable
Required Fio2	No	<30%	>30%
Increased HR & BP	No	11-20% or higher	>20% higher
Expression	None	Grimace	Grimace/grunt
Sleepless	No	Wakes frequent interval	Constantly awake

Scoring: If the score is ≥ 5 , administer analgesics to relieve pain. The scale should be used every 2 hours in first 24hours after painful procedures, followed by every 4 hours for at least 48 hours.

such as a nurse or physician. CRIES assesses crying, oxygenation, vital signs, facial expression, and sleeplessness

SUN Scale (Modified)

Compared to other scale it's easy to use. It has 5 parameters, each scored 0-2. There are 3 behavioral categories such as facial expression, CNS state, movement and 2 physiological categories such as breathing and heart rate.

Table 5: The Pain Assessment Tool (PAT)

Parameters	Description	Score
Posture/tone	Flexed and/or tense	2
	Extended	1
Sleep pattern	Agitated or withdrawn	2
	Relaxed	0
Expression	Grimace	2
	Frown	1
Cry	Yes	2
	No	0
Color	Pale/ dusky/ flushed	2
	Pink	0
Respiration	Apnea	2
	Tachypnea	1
Heart rate	Fluctuating	2
	Tachycardia	1
Saturations	Desaturation	2
	Normal	0
Blood pressure	Hypotensive/ hypertensive	2
	Normal	0
Nurse's perception	Yes pain	2
	No pain	0

Scoring

Score	Management
<5	Nursing Comfort Measures (NCM)
>5	Paracetamol and NCM
>10	Paracetamol, NCM and opioid (bolus/ infusion to be commenced)

Table 6: SUN Scale (Modified)

Parameters	Score	
Facial expression	Normal, relaxed	0
	Increased tension, furrowed brow	1
	Furrowed brow, tightly closed eyes, grimace, vigorous cry	2
Central nervous system state	Asleep or awake, quiet, calm	0
	Anxious, fussy	1
	Hyper-alert, panicked	2
Movement	Relaxed, normal tone	0
	Intermittent increased activity, flexion and extension of extremities	1
	Frequent flexion and extension or flaccid, minimal movements	2
Breathing	Quiet respiration, relaxed normal pattern. If intubated synchronized	0
	Intermittent increased rate >60. If intubated frequent non-synchrony	1
	Frequent increased rate >60. If intubated, fighting ventilator	2
Heart rate	Baseline	0
	Elevation 10%-15%	1
	Elevation >15%	2

Score: usually treat with score of 4 or more.

Neonatal Facial Coding System (NFCS)

This scale measures the facial expression of neonates during painful procedure.

Facial action monitored.

- a) Brow lowering
- b) Eyes squeezed shut
- c) Deepening of the naso-labial furrow
- d) Open lips
- e) Vertical mouth stretch
- f) Taut tongue (cupping of tongue)
- g) Chin quiver (high frequency vibration of the chin and lower jaw)
- h) Lip pursuing (tightening of the muscles around lips to form an "OO")
- i) Tongue protrusion (this can see only in preterm infants, not in term babies)

Interpretation

- Minimum score: 0
- Maximum score for premature infants :10

Table 7: Neonatal Facial Coding System (NFCS)

Action	Points
Did not occur	0
Occurred	1

Table 8: N-PASS Scale (Neonatal Pain, Agitation & Sedation Scale)

Assessment criteria	Sedation		Normal	Pain/ agitation	
	-2	-1	0	1	2
Crying Irritability	No cry with painful stimuli	Moans or cries minimally with painful stimuli	Appropriate crying Not irritable	Irritable or crying at intervals Consolable	High pitched or silent continuous cry Inconsolable
Behavior state	No arousal to any stimuli No spontaneous movement	Arouses minimally to stimuli Little spontaneous movement	Appropriate for gestational age	Restless, squirming Awakens frequently	Arching, kicking Constantly awake or arouses minimally/ no movements (not sedated)
Facial expression	Mouth is lax No expression	Minimal expression with stimuli	Relaxed appropriate	Any pain expression Intermittent	Any pain expression continual
Extremities Tone	No grasp reflex Flaccid tone	Weak grasp reflex Decreased muscle 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, SaO ₂	No variability with stimuli Hypoventilation or apnea	<10% variability from baseline with stimuli	Within baseline or normal for gestational age	Increase 10-20% from baseline SaO ₂ 76-85% with stimulation- quick increase	Increase in >20% from baseline SaO ₂ <75% with stimulation- slow increase Out of sync with vent

- Maximum score for full term infants :9

N-PASS Scale (Neonatal Pain, Agitation & Sedation Scale)

The N-PASS tool is used to assess sedation and agitation. Currently, this is the only scale for measuring pain that has also been used in the assessment of sedation in critically ill, premature neonates.

Scoring pattern

- Sedation does not need to be assessed or scored with every pain assessment.
- A score of 0 is given if infant's response to stimuli is normal for gestational age.
- Pain is scored from 0 to +2 for each behavioral and physiological criteria
- Total score in +10
- Score ≤ 3: start pain management

Management of pain

Management includes non-pharmacological (behavioral) and pharmacological ways.

Pharmacologic Treatment

Analgesia drugs should be chosen carefully based up on comprehensive assessment of the newborns. Efficacy and safety of the drug, the clinical setting, and experience of the personnel using the drug. Drug doses, including those for local anesthetics, should be calculated carefully based on the current or most appropriate weight of the neonate, and initial doses should not exceed maximal recommended amounts.

Examples:

- a) Morphine is the drug of choice for most situations requiring pain relief
- b) Morphine sulphate 0.05-0.1 mg/kg IV or Fentanyl 2-3 mic gr/kg IV
- c) Acetaminophen (oral) 10-15 mg/kg 4-12hrly up-to max 60mg/kg & rectal 20mg/kg/dose, 6-12hrly up to max 80mg/kg
- d) Fentanyl 0.25-0.5 micrograms /kg Q 4-6 hrs.

Non-pharmacologic treatment of neonatal pain (comfort measures)

- *Environmental Interventions*
 - a) Reduction of excessive light levels, and alternating day and light conditions can reduce stress, promote increased sleep and weight gain.
 - b) Toys: The sound produced from Toys like rattles, and keys alleviates crying and pain
- *Swaddling, Positioning and Touch*
 - a) Swaddling is the wrapping of infants in cloth to restrict their movements which reduce pain-elicited distress during and after heel prick.
 - b) Facilitated tucking, side lying or supine position with flexed arms and legs close to the trunk significantly lower the crying time, decrease mean sleep disruption time and decrease sleep states changes
- *Nonnutritive Suckling (NNS)*: The nonnutritive sucking of a pacifier or a gloved finger may decrease hyperactivity and regulate newborns' discomfort. NNS significantly decrease HR without stimulation, and during painful stimulation. **Blass and watt**, found that NNS is only effective when suck rate exceeds 30suck/min. It may also reduce the intensity and duration of acute pain in preterm and full term infants undergoing painful procedures. Its effects are associated with increased oxygenation, improvement in respiratory and gastrointestinal functions

(feeding by gavage), decreased heart rate and energy expenditure

- *Sucrose&Glucose*
 - a) 25% - 30% sucrose (glucose) 1.5 - 3ml PO ~ 2 minutes prior to the procedure for term new-borns
 - b) 25% sucrose (glucose) 0.5-1.5ml PO~2 minutes prior to the procedure for preterm NB
- *Skin to skin contact (kangaroo care)*: 10-15min skin to skin contact between mothers and their newborns reduces crying, grimacing, HR during heel lance procedure in full term.
- *Breast feeding*: Breast feeding during a painful procedure has been found to be a potent analgesic.
- *Music therapy*: Music defined as an intentional auditory stimulus with organized elements including melody, rhythm, harmony, timbre, form and style. However, it should be not provided for longer than 15min per intervention due to the risk of sensory overload

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