Physical Assessment of the Newborn

14 Pain Assessment in the Newborn

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Over the last several decades, there has been an increased awareness of the importance of assessing and managing pain in hospitalized newborns. One only has to spend time in the NICU to observe how frequently newborns encounter postoperative, procedural, and disease-related pain throughout their hospital stay. Although neonates cannot specifically communicate pain, they do display physiologic and behavioral cues that caregivers can use as objective and valid indicators of the infant’s pain experience. Caregivers must know the potential causes of pain and use a high index of suspicion when gauging the infant’s response cues for the presence, absence, or intensity of pain. The assessment of the infant’s response cues is an essential first step to optimally addressing the infant’s pain.

Approach to Pain Assessment

Pain assessment in the newborn and especially the preterm neonate presents a challenge to even the most skilled clinician. When the examiner depends on a pain score to identify pain consistently and accurately, this can lead to undertreated neonates because of the number of variables that affect physiologic and behavioral responses to painful stimuli. Pain assessment tools are useful insofar as a normal baseline is known and the score is interpreted based on a change from baseline parameters. If a patient is admitted in pain or baseline parameters are abnormal, the pain score may be misinterpreted, and undertreatment or overtreatment may occur. More information is required for interpreting pain in neonatal patients.

Infants needing neonatal intensive care may or may not respond to pain with clear signals. There are many reasons, such as low energy reserves, sedation, paralysis, and vague or unclear behavioral cues due to illness and/or prematurity. Therefore, a number of factors must be considered in assessing neonatal pain. A complete approach to assessment is required for the neonatal nurse to adequately determine the presence of pain, interpret the findings, and take action as an advocate for the patient (Figure 14-1). The process involves data collection, a systematic approach to evaluation, and a method of documentation.

Data Collection

Assessing pain in infants depends on systematically collecting various types of data, including the following (Figure 14-2):

- Demographic
- Historic
- Physiologic
- Behavioral
- Risk factors for pain
FIGURE 14-1 ▲ Pain assessment algorithm, generalized.

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For successful interpretation and intervention, nursing judgment and communication, both written and verbal, are vital. Without the whole process of collection, interpretation, and intervention, pain may go unobserved and untreated.

**Systematic Approach to Evaluation**

Data collection is only part of the process; it is what a nurse does with the data that will determine whether pain is viewed as being present. Sound nursing judgment comes from education about neonatal pain, experience, and a belief that pain assessment is essential for quality care in the NICU. Once the critical component of nursing judgment is present, the nurse can provide a convincing argument for pain intervention to medical staff. An overall approach to pain assessment that is systematic and provides guidance for nursing practice is shown in Table 14-1.5,6

**TABLE 14-1 ▲ Infant Pain Assessment Process**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Acknowledging pain cues/signs</td>
</tr>
<tr>
<td>2.</td>
<td>Hypothesizing the reason for distress</td>
</tr>
<tr>
<td>3.</td>
<td>Analyzing assessment data using nursing judgment</td>
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<tr>
<td>4.</td>
<td>Evaluating effectiveness of comfort measures</td>
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<tr>
<td>5.</td>
<td>Assessing consolability following comfort measures</td>
</tr>
<tr>
<td>6.</td>
<td>Speculating on the pain intensity</td>
</tr>
<tr>
<td>7.</td>
<td>Providing pain medication when indicated</td>
</tr>
<tr>
<td>8.</td>
<td>Reassessing at appropriate intervals for analgesic effectiveness or medication tolerance</td>
</tr>
</tbody>
</table>


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FIGURE 14-3  ▲ Pain scales with vital signs graph for trending pain signs.

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Key: D, disease; HR, heart rate; RR, respiratory rate; VS, vital signs

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In a quasi-experimental study, 24 pediatric nurses were asked to assess pain after viewing videotapes of infants (age range: birth to 12 months) and reading written clinical information. Their pain assessments were compared with assessments by 60 pediatric nurses who viewed the same videotapes but without the written background data. The nurses who only viewed the videotapes rated the pain level as significantly lower than those who also read background clinical information. These nurses were similar in age and experience, demonstrating that clinical information is important for the identification of pain, particularly in nonverbal patients. Nurses from the “video only” group also judged infants from 0–3 months as having lower pain levels than those 10–12 months. Therefore, judgment of pain requires the nurse to have complete information, especially for infants who demonstrate weak pain signals.

**Documentation**

Documentation of pain data should be done in a way that helps the caregiver analyze the infant’s current pain responses and trends over time. This information also allows the nurse to better communicate with the medical team when additional pain management is required. A single pain score provides immediate information about pain, but does not support analysis of fluctuating scores; adequacy of pain control; gradually increasing pain; or emerging tolerance to a particular medication, dose, or dose interval. Individual scores are useful when an acute event causes elevated pain scores. However, gradually increasing scores may be missed until the score is high enough to rate intervention. By that time, pain management may be more difficult. A documentation design that can be used in print or electronic format is a graph for plotting pain scores over time (e.g., 12 hours, 24 hours, 1 week). Subtle changes are easier to see if the documentation method allows for an overview of vital signs along with pain scores, as is the case when using a graphic display (Figure 14-3). Nurses familiar with the infant’s baseline assessment of vital signs and behaviors will be able to note the subtle variations over time, which may lead to better identification and management of pain.

**Assessment of Pain**

Pain assessment relies on the careful observational skills of the examiner. Pain can be assessed using behavioral measures or physiologic measures, but the best assessment is done when a multidimensional approach is employed.

**Behavioral Indicators**

The clinician can observe the infant’s facial activity, crying, and body movements to assess for the possibility that the infant is experiencing pain. A “cry face” (Figure 14-4) consisting of subtle changes in the infant’s facial expressions such as brow bulge, eye squeeze, and nasolabial furrow is the most specific indicator of acute
pain in newborns.\textsuperscript{8–12} Gestational age and behavioral state will have a significant impact on the infant’s facial expressions, with younger and sleeping infants having a diminished or delayed response.

The clinician can also observe and listen to the infant’s cry. Different types of cry—such as high-pitched, harsh, intense—may communicate the urgency or severity of distress.\textsuperscript{13,14} Absence of cry or objective signs of pain does not necessarily mean that the infant is not in pain, but may only signal that the infant’s response capability has been depleted.\textsuperscript{12,15–18}

Individual body movements can also provide helpful information about the infant’s pain experience. Infants, particularly healthy term newborns, may use reflexive limb withdrawal in response to noxious stimuli to signal pain.\textsuperscript{19} Because of inadequate muscle strength, posture, tone, and movement compared to term newborns, preterm neonates display less

\[\text{FIGURE 14-5 ▲ Premature Infant Pain Profile (PIPP): Revised.}\]

vigorous and robust pain responses. Other observed behaviors exhibited by preterm neonates include increased flexion and extension of arms and toe and finger splay.

**Physiologic Indicators**

Infants may also communicate pain through physiologic changes. The clinician can often observe vital sign changes on the infant's cardiorespiratory monitor to assess an infant's pain. Newborns will acutely respond to pain of handling or procedures with increases in heart rate and blood pressure while oxygen saturation decreases. However in prolonged pain, these physiologic parameters may not be valid indicators for assessment.

**Assessment Tools**

Pain assessment is best accomplished using a published pain assessment tool with known reliability and validity that has been demonstrated to be clinically useful and feasible in the clinical setting. The clinician should also consider choosing an instrument based on a similar infant population, setting, and type of pain. In order to best assess trends over time, the clinician should use the same tool over consecutive assessments when evaluating pain in a given newborn.

A multitude of pain assessment instruments exist and are constantly being developed. To improve the science around pain assessment, researchers should focus on validating or refining existing tools rather than continuing to develop new tools. The three most commonly used tools in the newborn are the Premature Infant Pain Profile (PIPP) developed by Stevens and associates, the CRIES developed by Bildner and Krechel, and the Neonatal Infant Pain Scale (NIPS) developed by Lawrence and colleagues.

The PIPP is the most reliable and valid tool available to assess pain in the neonatal clinical setting and has been validated in over 62 studies. The PIPP was originally developed to measure procedural pain, but has since been validated for use in postoperative pain. Although the PIPP may be presumed to be valid only with preterm neonates, it has been tested in neonates ranging in age from 24–48 weeks postconceptional age. Recently the PIPP has been revised (PIPP-R) to address construct validity and feasibility, allowing the caregiver to more easily apply the PIPP-R (Figure 14-5) in the clinical setting. The PIPP incorporates two contextual factors that may account for an infant’s less robust pain responses that can result from immaturity or behavioral state. By scoring infants who are younger or asleep higher on the PIPP, the adjusted scores do not penalize those known to be less capable of mounting a robust response to noxious stimuli. The PIPP contains two physiologic indicators (i.e., heart rate and oxygen saturation) and three facial indicators (i.e., brow bulge, eye squeeze, and nasolabial furrow). Physiologic and behavioral indicators are fairly straightforward to score when scoring procedural pain, but are often more challenging if used to score ongoing pain. If no clear 15-second baseline period is available for scoring, the clinician must sometimes judge baseline parameters using either preoperative vital signs or estimated vital signs before the known painful event. Although total scores vary between 18 and 21, depending on the infant’s gestational age, scores between 7 and 12 usually signify mild to moderate pain requiring nonpharmacologic comfort measures and possibly a mild analgesic. Scores greater than 12 indicate moderate to severe pain requiring pharmacologic pain intervention in addition to comfort measures.

The CRIES (Figure 14-6) is another instrument that has been used extensively to assess pain in the newborn. CRIES is an acronym for the five parameters it measures:
Pain Assessment in the Newborn

Physical Assessment of the Newborn

Crying, requires oxygen to maintain saturation greater than 95 percent, increased vital signs, expression, and sleepless. Although it was originally developed to assess postoperative pain in infants 32–36 weeks gestational age, studies have documented its clinical utility in gauging procedural pain in preterm and term neonates. Infants previously requiring oxygen are more difficult to score using the CRIES instrument. It provides no specific guideline for infants previously requiring oxygen, so nursing judgment is required to systematically adjust scores in this category to account for increases in oxygen levels above baseline values. In addition, if the CRIES is used for procedural pain assessment, baseline vital signs immediately before the procedure can be used for scoring the category of “increased vital signs.” Total scores for the CRIES range from 0 to 10, with scores less than 4 indicative of mild pain requiring nonpharmacologic pain relief measures and scores 5 or greater consistent with moderate to severe pain requiring pharmacologic intervention in conjunction with comfort measures.

The NIPS (Figure 14-7), like the PIPP, was originally developed to assess procedural pain in preterm and term newborns, but literature also validates its utility with postoperative pain. The NIPS examines five behavioral parameters (i.e., facial expression, crying, arms, legs, and state of arousal) and one physiologic parameter (i.e., breathing pattern). Total score ranges from 0 to 7. Scoring of the NIPS does not contain physiologic parameters requiring cardiorespiratory monitoring; therefore, this tool is particularly useful in assessing pain in healthy term infants. Although guidelines for pain interventions based on total score are not provided by the developers of the NIPS, all pain instruments in neonates are based on the premise of increasing pain intensity. Therefore, in tools without scoring guidelines for pain management, when pain scores reach the midrange of the total possible points for that tool (i.e., approximately 4 or greater with the NIPS), the clinician may infer that the infant is experiencing moderate to severe pain and pharmacologic intervention for that pain is warranted.

Special Populations

The evidence base on pain assessment is still limited for extremely low for gestational age (ELGA), neurologically impaired,
pharmacologically paralyzed or sedated, and other special populations of infants.

**Extremely Low for Gestational Age Infants**

Gestation at birth and postmenstrual age both affect pain response, with more robust responses to pain stimuli noted with advancing gestation and postmenstrual age. The ELGA infant’s lack of response does not necessarily indicate a lack of pain perception, but may be due to factors such as exhaustion, minimal energy reserves, protective apathy (resulting from the infant’s repeated attempts to communicate that he is in pain with no response from caregivers), or disease progression.

Preterm and term infant responses to pain differ from those of two- and four-month-old infants, who show no difference between each other in pain responses. Preterm infants demonstrate longer latency for cry and have higher-pitched cries; term newborns show more tautness of tongue than either preterm or older infants. Two- and four-month-old infants have more vertical mouth position than preterm or term newborns, who display more horizontal mouth action.

Facial actions in both preterm and term infants have been demonstrated to show more sensitivity and specificity to pain than physiologic parameters, and some behaviors such as crying may be influenced by a variety of conditions such as hunger, agitation, a stressful environment, and repositioning.

ELGA infants who are less than 27 weeks postmenstrual age have pain responses similar to more mature infants, although a decreased
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intensity of responses is noted. The preterm infant’s pain response is affected by severity of illness, previous pain experiences, number of painful procedures, and medications. Cry is not a sensitive indicator for pain in ELGA infants because many are intubated, on continuous positive airway pressure (CPAP), or lack the energy for crying.41

**Neurologically Impaired Infants**

A survey of direct care staff suggests there is a generalized perception that, as the level of neurologic impairment increases from mild to moderate to severe, the infant experiences progressively less pain compared to infants without impairment.44,45

Stevens and colleagues conducted a study using Delphi methodology to gain group consensus among 14 pediatric pain experts on pain indicators thought to be characteristic of infants at risk for neurologic impairment (low, moderate, severe risk). The highest level of agreement among experts on pain indicators in infants at risk for neurologic impairment was on brow bulge, facial grimace, eye squeeze, and inconsolability. The expert panel also agreed that, for the severe risk group, heart rate changes and decreased oxygen saturation were important indicators of pain.46

Another study found infants at a postmenstrual age of approximately 32 weeks with Grade IV intraventricular hemorrhage or cystic periventricular leukomalacia by

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ultrasound showed no signs of altered pain response compared with matched controls. The infants with parenchymal brain injury demonstrated significantly more tongue protrusion upon heel lance. The researchers also noted that pain responses of these infants may change as they grow and develop. Abnormal pain responses later in infancy may become apparent as neurodevelopmental abnormalities that blunt or alter biobehavioral reactivity emerge. A study, published in 2008, by Gibbins and colleagues found that behavioral and physiologic pain responses in at-risk infants were diminished at six months of age compared to the neonatal period.

**Pharmacologically Paralyzed or Sedated Infants**

Infants receiving moderate to heavy sedation or paralytic agents cannot mount a behavioral response to pain. Risk factors for pain should be carefully considered, and physiologic measures of pain should be used in the absence of behavioral indicators. Unfortunately, there are no available pain instruments for use with this special NICU population. However, near-infrared spectroscopy (NIRS) shows promise as a tool to evaluate cortical pain somatosensory activation in the absence of behavioral measures and may be a future technology used to assess pain in these infants.

**Infants with Persistent or Chronic Pain**

Prolonged or persistent pain is not well described due to limited research, especially in the preterm population. Most of the research on neonatal pain consists of an acute pain stimulus (heel lance) or postoperative pain. In one study, 22 ventilated preterm infants, randomized to receive morphine or a placebo, were assessed for ongoing or persistent pain by clinical staff including nurses and doctors. Infants on morphine therapy were correctly identified by staff members 71 percent of the time. Pain-related facial expressions (grimacing), high activity levels, poor response to handling or routine care, and insufficient ventilatory synchrony were associated more with infants on placebo than those receiving morphine.

Initial validation with the EDIN (Échelle Douleur Inconfort Nouveau-Né [Scale of Pain and Discomfort Newborn]) scale for assessing prolonged pain in preterm infants is promising, but requires additional research. A study by Ancora and colleagues showed that gestational age affected EDIN scores of infants exposed to prolonged pain. EDIN scores were lowest in the extremely low birth weight (ELBW) infants as compared to infants who were gestationally more mature. Five behavioral indicators with increasing scores indicating prolonged pain comprise this scale: facial activity, body movements, quality of sleep, quality of nurse-infant interaction, and consolability (Figure 14-8).

More subdued responses may be seen in infants with chronic pain, or a complete shutdown may become apparent when pain exceeds the infant’s ability to respond, as with any overwhelming stimulation. These reactions may be caused by the ongoing nature of persistent or chronic pain, where the usual pain signals do not result in relief, thus resulting in a negative feedback loop.

**Infants Exposed to Psychotropic Medications**

Infants exposed prenatally or postnatally through breast milk to selective serotonin reuptake inhibitors (SSRIs) and benzodiazepines demonstrate significantly decreased facial action and less cardiac reactivity during heel lance than those not exposed to psychotropic medications. Mean heart rate was significantly lower during

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recovery from heel lance for the SSRI-exposed infants.56,57

**Infants Undergoing Opioid Weaning**

Screening for pain should continue during opioid weaning. One might suspect recurring pain in infants with increased neonatal abstinence scores who frequently need extra doses of opioids above the weaning dose for symptom management. Although alternate dosing of opioids and benzodiazepines has not been studied in neonates during weaning, this combination might diminish the pain response in infants still experiencing pain. Pain screening with a validated tool in combination with neonatal abstinence scoring can alert the clinician to the presence of pain because some indicators differ between instruments. For example, facial grimacing, a sensitive indicator of pain, is not on abstinence scoring tools.

Iatrogenic withdrawal differs from neonatal abstinence in that dependence results from medications to alleviate pain. Therefore, pain may be inadequately treated if medications are weaned before the cause of pain diminishes. Health care providers must be able to distinguish between iatrogenic withdrawal and neonatal abstinence syndrome.58

**Infants at End of Life**

Currently, there is no appropriate tool sensitive to neonatal pain at the end of life. Choice of an assessment tool depends on the individual patient (e.g., a preterm infant might be best evaluated using the PIPP to account for gestational age). Often, infants who are terminally ill do not have the energy to express pain behaviorally. Significant impairment of the terminally ill infant’s communication ability could compromise comfort. Physiologic indicators may be the only available parameters, and these might be affected by the dying infant’s condition. Therefore, it is reasonable to use physiologic indicators, risk factors for pain, and an infant’s general condition to help determine pain at this time.49

There is great variation in the provision of analgesics to infants during and after ventilator withdrawal, with many infants receiving no analgesia. Infants with major chromosome abnormalities, congenital anomalies, and necrotizing enterocolitis (NEC) were more likely to receive analgesia than those with other diagnoses or for whom further treatment was considered futile.59,60 The provision of analgesics is frequently based on obvious risk factors for suffering as life support is withdrawn or for known painful conditions. Frequently, infant behaviors are not documented as the reason for administering pain medications.61 As stated, the inability to demonstrate behavioral pain responses leaves the clinician without clear indices for assessment. Therefore, it may be necessary to consider that infants may have increasing pain intensity as death becomes imminent. Clearly, a population that receives little or no analgesia at a time when most older children and adults receive compassionate analgesia indicates a different standard of care and warrants a close examination of clinical practice. In some institutions, palliative care teams provide support for the patient and family and serve as consultants for pain management of the neonate during end of life.

**Infants with Diseases or Conditions Warranting Pain Assessment**

One way to think about pain related to particular conditions is to consider whether the condition would be painful in an older child or adult. If the answer is “yes,” then pain needs to be frequently assessed. Tests, procedures, or wound care may increase the level of pain and require careful observation to determine the need for pain medication. Some conditions such as *epidermolysis bullosa* (EB)
Pain Assessment in the Newborn

Physical Assessment of the Newborn

require varying amounts of analgesia, from ongoing baseline pain control to control of acute pain when dressings are changed. A study of 140 randomly selected children and 374 adults with various types and subtypes of EB found that only 12–13 percent reported no pain. Individuals with more extensive EB and EB subtypes reported pain levels greater than 5 on a 10-point pain scale.

Another study of 35 children, ages 5–18, with osteogenesis imperfecta found they experienced moderate to severe pain related to fractures and less intense pain when no fractures were present. With nonverbal patients, it would be easy to assume that they have no pain when they have no fractures. This would lead to undertreatment of pain in this population. These patients may experience acute pain during repositioning or other care not usually considered painful.

In a retrospective chart review of 25 infants with NEC, it was noted that infants averaged 13–19 painful events per day for five days. Although the unit standard was to document two PIPP scores per day, compliance was less than 8 percent. For two days after NEC was diagnosed, only 30 percent of infants had pain scores documented in the medical record. From day 3 through day 5, PIPP scores were documented on 60 percent of the infants. On day 1 of diagnosis, 52 percent of infants were given analgesia, and on day 2 the percentage receiving analgesia rose to 76 percent. After day 2, the frequency of analgesic treatment slowly declined. In this study, the use of opioid analgesics for NEC was low, possibly in association with inadequate screening assessments for pain.

Many conditions in the NICU result in prolonged pain that can affect the nature of biobehavioral responsiveness, and the onus of responsibility is on the clinician to appropriately determine if the infant is in pain. When pain is questionable, a compassionate clinician can always err on the side that pain is present, initiate a trial of analgesic therapy, and evaluate infant response.

**Parents’ Views on Pain**

Surveys of parents regarding pain assessment and management for their infant in the NICU provide some guidance concerning their needs associated with neonatal pain. In one survey of 257 parents from nine NICUs in the United Kingdom and the United States, 64 percent of parents were dissatisfied because they received no information about infant pain. Thirty percent of parents were disappointed with the information they had received. Only 18 percent of parents reported being taught by NICU staff how to identify their infant’s pain signals. Seventy percent of parents wrote comments on ways they identified their infant’s pain signs, with crying (37 percent), movements (31 percent), or facial expression (21 percent) the most commonly reported. Very few parents used skin color or cardiorespiratory monitor data for pain assessment.

A study by Franck and colleagues in 2011 provided parents with written information on pain assessment and comfort techniques. Study findings demonstrated that while maternal satisfaction increased, stress was not reduced. Timing of information received and increased involvement opportunities were important to NICU parents. Consideration of the parents’ emotional states and quality of NICU staff communication and support are positively related to parents’ desired level of participation.

Interviews and focus groups with parents show that their infant’s pain is a source of stress and that health team members have an important role in alleviating that stress. The ability to participate in parenting their infant seems to provide a coping mechanism that

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relieved some of the distress associated with the pain their infant endured in the NICU. Parents felt there was a difference between their perceptions of their infant’s pain and the perceptions of NICU staff members. This disparity increased their anxiety, as did the concern that staff might not intervene when presented with signs of pain by their infant after the parents left the NICU. These issues heightened parental stress; whereas support by NICU staff, parenting opportunities, and information or resources relieved it.

**Summary**

Pain assessment is an essential prerequisite to optimal pain management. Pain is best assessed when a multidimensional approach is employed using a valid and reliable instrument. Balancing pain assessment data with the infant’s risk factors for pain and contextual modifiers that can impact how the infant communicates pain will ensure that pain is recognized early and interventions are implemented in a timely manner.

**References**

Physical Assessment of the Newborn


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**Notes**