Pain Assessment in Children Undergoing Regional Anesthesia

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6.1 Background

Effective pain management is a key objective of proper patient care. Adequate pain management has the potential to improve health, facilitate healing, and reduce long-term negative results of pain after hospitalization [1]; poor pain management is inhumane and unethical. Inherent to good pain management is skilled pain assessment, and practice standards have been developed mandating effective pain assessment and management across the life span [2]. For example, effective pain assessment and management and staff education on these topics are now required for institutional accreditation in the United States [3].

Children are a particularly vulnerable clinical population who are at risk for poor pain management for a variety of reasons. A child's developmental level and ability to communicate play important roles in pain assessment and management [4]. The medical history of the child can also play an important role in pain assessment. Previous experience with medical procedures, particularly painful medical procedures, can markedly affect a child's response to pain, pain behaviors, and potentially even the child's perception of pain [5].

Sadly, not only are children vulnerable to undertreatment of pain, they are also especially at risk for experiencing negative consequences resulting from poor pain control. For example, neonates who experience less analgesia following painful procedures are more likely to experience augmented pain and increased behavioral changes during and following subsequent painful stimuli [6–8]. It has been found that these changes result from alterations in the central nervous system through processes such as central sensitization, windup, receptive field alteration, and even altered gene expression [9, 10]. Pain-related stress responses also affect hormonal responses, homeostatic function, immune function, infection rates, disease progression, and mortality rates [11, 12]. In addition, children often have less control over their environments and can be strongly affected by their parents' behaviors, including parental responses to medical settings and medical procedures [13].

In considering how to effectively assess pain in a clinical setting, there are many factors to be aware of and a variety of dimensions of pain that could potentially be assessed. Current pain theory falls within the widely validated biopsychosocial model. This chapter will discuss a number of important aspects of pain assessment in children undergoing medical procedures. An outline of validated measures is included along with practical guidelines for their use, and the importance of these guidelines for assessing biological, psychological, and social factors will be reviewed. These factors have the potential to impact a child's pain and the resulting response to pain in the clinical setting as well as following post-hospital discharge. The best practice standards based on current guidelines will also be reviewed and will be discussed with a particular focus on pain assessment relevant to regional anesthesia practice.

6.2 Principles of Pain Assessment in Infants and Children

Assessing pain in pediatric patients is often challenging due to the subjective personal nature of pain and the difficulty that children can have in verbally reporting pain. Pain is a multidimensional phenomenon, and pain measurement tools need to capture the many important aspects of pain. It is important to note that measurements of pain intensity, often used in acute care settings, are only one part of a comprehensive pain assessment [14]. Pain assessment tools should be reliable, valid, developmentally appropriate, clinically useful, and practical to use [15]. Utilizing multiple measures, such as behavioral and physiological data, may result in a more accurate assessment [16]. Several reliable and valid measures exist to assist in assessing pain in pediatric patients undergoing procedures, including self-reporting, behavioral observations, and physiological measures. The pain assessment tools included in the following section have been validated for use in pediatric patients experiencing acute postoperative pain.

6.3 Assessing Pain in Neonates and Infants

Neonates and infants under the age of 1 month often undergo painful interventions, including surgical procedures, venipunctures, and heel lances [17]. Assessing pain in this vulnerable population requires multidimensional measures, as infants are preverbal and cannot communicate their pain with words [18]. Recent reviews have shown that while over 40 tools have been developed for assessing pain in these children, no one tool has been identified as ideal [19–21]. Many of the tools such as the Neonatal Facial Coding System (NFCS) [22] and the Neonatal Infant Pain Scale (NIPS) [23] are useful for the assessment of short-term acute pain involved in medical procedures, such as venipunctures, but their usefulness for painful experiences of longer duration such as postoperative pain is limited [18]. Tools with demonstrated validity in assessing postoperative pain in neonates and infants include the Premature Infant Pain Profile (PIPP), the Neonatal Pain Agitation and Sedation Scale (N-PASS), and CRIES (Table 6.1). These tools will be described below, including information about their development, content, validation, and reliability.

Table 6.1 Pain assessment tools for neonates

Tool	Reference	Age range	Clinical indications for use	Guidelines for use	Advantages and disadvantages
PIPP	Stevens et al. [24]; McNair et al. [25]	28–40 weeks gestational age	Procedural pain, postoperative pain	Score ranges from 0 to 3 in each indicator, scores can range from 0 to 21 in infants less than 36 weeks gestation, maximum score 21 in infants over 36 weeks gestation	Includes cutoff scores for mild, moderate, and severe pain Multidimensional; 7 indicators, including two physiological, three behavioral, and two contextual
N-PASS	Hummel et al. [26]	0–100 days old; 23 weeks gestation and above	Ventilated and/or postoperative infants	Scoring determines whether infant is sedated or in pain	Multidimensional; 5 indicators, including four behavioral and one physiological. Measures sedation and pain on a continuum. Includes scoring criteria for corrected age. Has been validated in ventilated infants
CRIES	Krechel and Bildner [27]	32–60 weeks gestational age	Postoperative infants	Scoring ranges from 0 to 2 in each of the 5 indicators for a total score of 0–10	Multidimensional; 5 indicators, including two physiological and three behavioral

6.3.1 The Premature Infant Pain Profile (PIPP)

This tool consists of a seven-item, 4-point scale that measures behavioral, physiological, and contextual indicators [24] (Fig. 6.1). These measures include gestational age, behavioral state, oxygen saturation, brow bulge, eye squeeze, and nasolabial furrows. Initial reliability and validity testing involved procedural pain such as heel lance, circumcision, and venipuncture. Research on the PIPP has demonstrated construct validity of the tool as a measure of prolonged post-operative pain in premature infants who underwent surgical procedures [25].

Infant Study Number: ______________________
Date/time: ______________________
Event: ______________________

Process	Indicator	0	1	2	3	Score
Chart	Gestational age	36 weeks and more	32–35 weeks, 6 days	28–31 weeks, 6 days	less than 28 weeks	
Observe infant 15 s	Behavioral state	active/awake eyes open facial movements	quiet/awake eyes open no facial movements	active/sleep eyes closed facial movements	quiet/sleep eyes closed no facial movements	
Observe baseline Heart rate ___ Oxygen saturation ___						
Observe infant 30 s	Heart rate Max ___	0–4 beats/min increase	5–14 beats/min increase	15–24 beats/min increase	25 beats/min or more increase	
	Oxygen saturation Min ___	0–2.4 % decrease	2.5–4.9 % decrease	5.0–7.4 % decrease	7.5 % or more decrease	
	Brow bulge	None 0–9 % of time	Minimum 10–39 % of time	Moderate 40–69 % of time	Maximum 70 % of time or More	
	Eye squeeze	None 0–9 % of time	Minimum 10–39 % of time	Moderate 40–69 % of time	Maximum 70 % of time or More	
	Nasolabial furrow	None 0–9 % of time	Minimum 10–39 % of time	Moderate 40–69 % of time	Maximum 70 % of time or More	
					Total score	

Fig. 6.1 Scoring method for the premature infant pain profile (PIPP) (Adapted from Stevens et al. [24]. With permission from Wolters Kluwer Health)

6.3.2 Neonatal Pain Agitation and Sedation Scale (N-PASS)

The N-PASS [26] consists of five indicators that have demonstrated reliability and validity as pain measures in various neonatal pain assessment scales (Fig. 6.2). These indicators are cry/irritability, behavior state, facial expression, extremities/tone, and vital signs. The tool was tested on infants in the neonatal intensive care unit who had received surgical procedures [26]. The infants ranged in postnatal age from 0 to 100 days, and gestational age ranged from 23 to 40 weeks. Convergent validity, assessed by correlation with the PIPP, was 0.83 at high pain scores and 0.61 at low pain scores. Inter-rater reliability was high (0.85–0.95). The N-PASS is validated up to 3 years of age.

N-PASS:
Neonatal Pain, Agitation, & Sedation Scale

Assessment Criteria	Sedation		Sedation/Pain	Pain / Agitation	
	-2	-1	0/0	1	2
Crying Irritability	No cry with painful stimuli	Moans or cries minimally with painful stimuli	No sedation/ No pain signs	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	No sedation/ No pain signs	Restless, squirming Awakens frequently	Arching, kicking Constantly awake or Arouses minimally / no movement (not sedated)
Facial Expression	Mouth is lax No expression	Minimal expression with stimuli	No sedation/ No pain signs	Any pain expression intermittent	Any pain expression continual
Extremities Tone	No grasp reflex Flaccid tone	Weak grasp reflex ↓ muscle tone	No sedation/ No pain signs	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	No sedation/ No pain signs	↑ 10-20% from baseline SaO_2 76-85% with stimulation - quick ↑	↑ > 20% from baseline SaO_2 ≤ 75% with stimulation - slow ↑ Out of sync/fighting vent

Premature Pain Assessment → + 1 if <30 weeks gestation / corrected age

Fig. 6.2 N-PASS assessment table. Used with permission

6.3.3 CRIES

CRIES [27] is a tool that measures five physiological and behavioral variables: C-crying, R-requires increased oxygen administration, I-increased vital signs, E-expression, and S-sleepiness (Fig. 6.3). The tool was tested on infants between 32 and 60 weeks gestational age who underwent surgical procedures, including insertion of ventriculoperitoneal shunts and thoracotomies. Construct validity was established by comparing scores pre- and post-analgesia administration. Inter-rater reliability was found to be acceptable ($r = 0.72$).

Date/time						
Crying - Chracteristic cry of pain is high pitched. 0 – No cry or cry that is not high-pitched 1 – Cry high pitched but baby is easily consolable 2 – Cry high pitched but baby is inconsolable						
Requires O_2 for SaO_2 <95 % - Babies experiencing pain manifest decreased oxygenation. Consider other cause of hypoxemia, e.g., oversedation, atelectasis, pneumothorax) 0 – No oxygen required 1 – <30 % oxygen required 2 – >30 % oxygen required						
Increased vital signs (BP* and HR*) - Take BP last as this may awaken child making other assessments difficult 0 – Both HR and BP unchanged or less than baseline 1 – HR or BP increased but increase in <20 % of baseline 2 – HR or BP is increased >20 % over baseline.						
Expression - The facial expression most often associated with pain is a grimace. A grimace may be characterized by brow lowering, eyes squeezed shut, deepening naso-labial furrow, or open lips and mouth. 0 – No grimace present 1 – Grimace alone is present 2 – Grimace and non-cry vocalization grunt is present						
Sleepless - Scored based upon the infant's state during the hour preceding this recorded score. 0 – Child has been continuously asleep 1 – Child has awakened at frequent intervals 2 – Child has been awake constantly						
Total score						

Fig. 6.3 CRIES neonatal pain assessment tool. Used with permission

6.3.4 Assessing Postoperative Pain in Infants and Young Children

Although most children over the age of 18 months are verbal, their ability to communicate pain may still be limited to crying or to providing information only about the presence or absence of pain. Assessing pain in infants and preschool age children is best accomplished by measures that include behavioral manifestations of pain. Tools that have shown reliability and validity in assessing postoperative pain in infants and young children include the Faces, Limb, Activity, Cry, and Consolability (FLACC) scale for hospital use and the Parents' Postoperative Pain Measure (PPPM) for use at home [28].

6.3.4.1 FLACC (Faces, Limb, Activity, Cry, and Consolability)

The FLACC [29] has been shown to be a reliable tool for measuring postoperative pain in young children (Fig. 6.4). The acronym FLACC incorporates the different domains of the assessment – Facial expression, Leg movement, Activity level, Cry, and Consolability. Each domain receives a score between 0 and 2 for a total score of between 0 and 10. Initial testing of the tool involved assessment of children between 2 months and 7 years of age who had undergone surgical procedures in the postanesthesia care unit. Inter-rater reliability was found to be high using simultaneous independent evaluations ($r = 0.94$). Validity testing has demonstrated that FLACC scores decrease with analgesia administration in children under the age of 3 years [30].

6.3.4.2 Parents' Postoperative Pain Measure (PPPM)

The Parents' Postoperative Pain Measure [31] has been validated as a measure for home use in children who are discharged to home following day surgery procedures. This 15-item tool includes cutoff scores which show excellent sensitivity and specificity (>80 %) in determining clinically meaningful pain scores. The initial validation of this tool was completed on children ages 7–12 years undergoing procedures which were ranked by experts into three classes – highly painful (e.g., tonsillectomies), moderately painful (e.g., sinus surgeries), or little or no pain (e.g., myringotomies). Further validation of the PPPM [32] demonstrated that the tool is a reliable valid measure for home use on children between the ages of 2 and 6 years.

Categories	Scoring		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractable	Difficult to console or comfort
Each of the five categories (F) Face; (L) Legs; (A) Activity; (C) Cry; (C) Consolability is scored from 0-2, which results in a total score between zero and ten.			

Fig. 6.4 FLACC pain assessment tool (Based on data from Ref. [29])

6.4 Assessing Pain in Children and Adolescents

Children over the age of 3 years can often provide reliable information about the intensity or severity of their pain using validated self-report scales. Much of the research related to pain assessment tools for this population has focused on the use of the scales in clinical trials rather than in clinical practice. The Pediatric Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (Ped-IMMPACT) by Stinson et al. [33] reviewed 34 self-report tools and found that while no single tool was optimal for all types of pain, six were shown to be reliable and valid for acute pain (Table 6.3). The Faces Pain Scale [34] and Faces Pain Scale-Revised [35] have both been shown to be reliable, valid, simple, easy to use, and require minimal instruction. Other recommended pain scales include the Oucher, the Pieces of Hurt, the Wong-Baker FACES Pain Scale, and the Visual analogue scale. Numeric rating scales are frequently used in clinic practice. Each of these scales is discussed below.

6.4.1 Faces Pain Scale-Revised

The Faces Pain Scale-Revised [35] has been translated into more than 40 languages and can be obtained free of charge for use in clinical practice. Obviously, it is important when using pain assessment tools with young verbal children to communicate in a language that they understand whenever possible. These pictorial scales with accompanying instructions have a series of six faces that the child points to, indicating how much they hurt or how sore they feel. This scale has strong psychometric properties and is widely used in research and clinical practice internationally.

6.4.2 Numeric Rating Scales (NRS)

Older children are often asked to rate their pain using these scales (Fig. 6.5). The NRS is generally composed of an 11-point numeric rating scale, with anchors of 0 (No Pain) and 10 (Worst Pain Imaginable). A recent publication by von Baeyer et al. [36] reviewed the use of the numeric rating scale to define age limits for which it would be appropriate and concluded that the scale is supported for use in children over the age of 8 years.

6.4.3 Oucher

The Oucher [37] consists of a numeric rating scale combined with six photographs of children's faces. Caucasian, African-American, Hispanic, First Nations (boy/girl), and Asian (boy/girl) versions are available. Using this scale, the child chooses the face that best reflects the pain level. The picture selection is then converted to a number between 0 and 10. The scale must be printed in color in order for the child to accurately see the faces, making it a more expensive tool to use.

6.4.4 Pieces of Hurt/Poker Chip Scale

The Pieces of Hurt, or Poker Chip Scale [38], consists of four chips or pieces of hurt. The child chooses how many pieces of hurt they are experiencing. The tool is difficult to use in postoperative care in hospitals because of infection control concerns and availability of poker chips on the unit.

6.4.5 Wong-Baker FACES Pain Scale

The Wong-Baker FACES Pain Scale [39] is a reliable and valid tool for assessing pain in children over 3 years of age. It is similar to the Faces Pain Scale-Revised in that it consists of a series of six cartoon faces depicting "no hurt" to "hurts worst." The child then chooses the face that best describes his/her pain. Recent research [40, 41] has found that children's pain ratings are influenced by the pictorial anchors, as the "no pain" face has a smile and the "most pain" face has tears. These findings suggest that the faces in this scale may measure pain affect rather than pain intensity.

6.4.6 Visual Analogue Scale (VAS)

The visual analogue scale (VAS) [42], which has several forms, is composed of a line with the words "no pain" and "worst" or "most pain" as anchors (Fig. 6.6). The line can be vertical or horizontal. The child is asked to mark a point on the line to indicate pain intensity. The VAS has been used extensively in research studies. It is not as clinically useful as a tool as it may be difficult to interpret and difficult to include in a chart document and requires careful explanation to the child. Debate continues as to optimal line length and the choice of anchor words.

6.4.7 Children's Hospital of Eastern Ontario Pain Scale (CHEOPS)

The Children's Hospital of Eastern Ontario Pain Scale [43] is a time-sampling behavioral pain scale. It looks for behaviors related to six items: cry, facial, child verbal, torso, touch, and legs. Each behavior listed under each item is given a numerical score and definition. The numerical scores are assigned based on the following criteria: 0 is behavior that is the antithesis of pain; 1 is behavior not indicative of pain, and not the antithesis of pain; 2 is behavior indication of mild or moderate pain; and 3 is behavior indicative of severe pain. Therefore, the total score can be from 4 to 13 for each time period sampled. It showed good inter-rater reliability, with average percentage of agreement by patients ranging from 90 to 99.5 %.

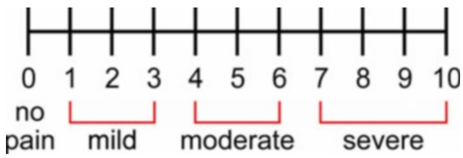

Fig. 6.5 Numeric rating scale (NRS)

Fig. 6.6 Visual analogue scale (VAS). A 10-cm scale is recommended; the child marks a point along the scale that corresponds with his/her pain. A ruler is then used to determine the score by measuring the distance between the "no pain" anchor and the mark

6.5 Assessing Postoperative Pain in Critically Ill Children

Assessing postoperative pain in critically ill children in an intensive care unit requires multidimensional tools. If a critically ill child is not sedated, a self-report should be obtained where possible. However, for many of these children, sedation is a required part of their care, making valid assessment by self-reporting more difficult. The COMFORT scale [44, 45] (Fig. 6.7) was developed to assess distress in critically ill children. In many critically ill children, pain may be a contributor to the distress. The COMFORT scale consists of behavioral and physiological indicators. The tool requires extensive training of clinical staff but is one of the few tools validated for use in this population. The modified FLACC [46] is valid in measuring postoperative pain in intubated children. The Cry section is modified to reflect the facial expression associated with crying.

Patient Sticker

Date ______________________ Time ______________________

Observer ______________________

Alertness	• Deeply asleep (eyes closed, no response to changes in the environment)	❏ 1
	• Lightly asleep (eyes mostly closed, occasional responses)	❏ 2
	• Drowsy (child closes his or her eyes frequently, loss respansive to the environment)	❏ 3
	• Awake and alert (child responsive to the environment)	❏ 4
	• Awake and hyperalert (exaggerated responses to the environmental stimuli)	❏ 5
Calmness–Agitation	• Calm (child appears serene and franquil)	❏ 1
	• Slightly anxious (child shows slight anxiety)	❏ 2
	• Anxious (child appers agilated but remains in control)	❏ 3
	• Very anxious (child appears very agilated, just able to control)	❏ 4
	• Panicky (child appears severely distressed, with loss of control)	❏ 5
Respiratory response (score only in mechanically ventilated children)	• No spontaneous respiration	❏ 1
	• Spontaneous and ventilator respiration	❏ 2
	• Restlessness or resistance to ventilator	❏ 3
	• Active breathing against ventilator or regular coughing	❏ 4
	• Fighting against ventilator	❏ 5
Crying (score only in childran breathing spontaneously)	• Quiet breathing, no crying sounds	❏ 1
	• Occasional sobbing or moaning	❏ 2
	• Whining (monotone)	❏ 3
	• Crying	❏ 4
	• Screaming or shricking	❏ 5
Physical movement	• No movement	❏ 1
	• Occasional (3 or fewer) slight movements	❏ 2
	• Frequent (more than 3) slight movements	❏ 3
	• Vigorous movements limited to extremities	❏ 4
	• Vigorous movements including lorso and head	❏ 5
Muscle tone	• Muscles totally relaxed, no muscle tone	❏ 1
	• Reduced muscle tone, less resistance than normal	❏ 2
	• Normal muscle tone	❏ 3
	• Increased muscle tone and flexion of fingers and loes	❏ 4
	• Extreme muscle rigidity and flexion of fingers and loes	❏ 5
Facial tension	• Facial muscles totally relaxed	❏ 1
	• Normal facial tone	❏ 2
	• Tension evident in some facial muscles (not sustained)	❏ 3
	• Tension evident throughout facial muscles (sustained)	❏ 4
	• Facial muscle contorted and grimacing	❏ 5
	Total Score	

VAS (Visual Analogue Scale)
Put a mark on the line below to indicate how much pain you think the child has **at this very moment.**

no pain |————————————————| worst pain **VAS Score**

Treatment datails

Datails of child's condition

Assessments made
(before or after medication or standard assessment)

Fig. 6.7 COMFORT scale for pain assessment in critically ill children (Reprinted from van Dijk et al. [45]. With permission from Wolters Kluwer Health)

6.6 Assessing Postoperative Pain in Children with Cognitive Impairments

Assessing postoperative pain in children with cognitive impairments requires the use of multidimensional tools and parental input. It can be difficult to determine which behaviors are pain related in this population. The Non-Communicating Children's Pain Checklist-Postoperative Version (NCCPC-PV) by Breau et al. [47] (Fig. 6.8) demonstrated good inter-rater reliability and included cutoff scores to determine mild or moderate to severe pain. The tool requires a 10-min observation of behaviors in six domains – vocal, social, facial, activity, body and limbs, and physiological. The FLACC has also shown reliability and validity in assessing postoperative pain in children with cognitive impairments. Malviya et al. [48] utilized the FLACC as well as individualized behaviors identified by the parent for each child in assessing pain postoperatively in children aged 4–19 years with cognitive impairments.

Non-communicating Children's Pain Checklist – Postoperative Version (NCCPC-PV)

NAME: ______	UNIT/FILE #: ______	DATE: ______ (dd/mm/yy)
OBSERVER: ______	START TIME: ______ AM/PM	STOP TIME: ______ AM/PM

How ofetn has this child shown these behaviours in the last 10 minutes? Please circle a number for each behaviour. If an item does not apply to this child (for example, this child cannot reach with his/her hands), then indicate "not applicable" for that item.

0 = NOT AT ALL 1 = JUST A LITTLE 2 = FAIRLY OFTEN 3 = VERY OFTEN NA = NOT APPLICABLE

I. Vocal					
1. Moaning, whining, whimpering (fairly soft)	0	1	2	3	NA
2. Crying (moderately loud)	0	1	2	3	NA
3. Screaming/yelling (very loud)	0	1	2	3	NA
4. A specific sound or word for pain (e.g., a word, cry or type of laugh)	0	1	2	3	NA
II. Social					
5. Not cooperating, cranky, irritable, unhappy	0	1	2	3	NA
6. Less interaction with others, withdrawn	0	1	2	3	NA
7. Seeking comfort or physical closeness	0	1	2	3	NA
8. Being difficult to distract, not able to satisfy or pacify	0	1	2	3	NA
III. Facial					
9. A furrowed brow	0	1	2	3	NA
10. A change in eyes, including: squinching of eyes, eyes opened wide, eyes frowing	0	1	2	3	NA
11. Turning down of mouth, not smiling	0	1	2	3	NA
12. Lips puckering up, tight, pouting, or quivering	0	1	2	3	NA
13. Clenching or grinding teeth, chewing or thrusting tongue out	0	1	2	3	NA
IV. Activity					
14. Not moving, less active, quiet	0	1	2	3	NA
15. Jumping around, agitated, fidgety	0	1	2	3	NA
V. Body and Limbs					
16. Floppy	0	1	2	3	NA
17. Stiff, spastic, tense, rigid	0	1	2	3	NA
18. Gesturing to or touching part of the body that hurts	0	1	2	3	NA
19. Protecting, favoring or guarding part of the body that hurts	0	1	2	3	NA
20. Flinching or moving the body part away, being sensitive to touch	0	1	2	3	NA
21. Moving the body in a specific way to show pain (e.g. head back, arms down, curls up, etc.)	0	1	2	3	NA
VI. Physiological					
22. Shivering	0	1	2	3	NA
23. Change in color, pallor	0	1	2	3	NA
24. Sweating, perspiring	0	1	2	3	NA
25. Tears	0	1	2	3	NA
26. Sharp intake of breath, gasping	0	1	2	3	NA
27. Breath holding	0	1	2	3	NA

SCORE SUMMARY:

Category:	I	II	III	IV	V	VI	TOTAL
Score:							

Fig. 6.8 The Non-Communicating Children's Pain Checklist-Postoperative Version (NCCPC-PV). Used with permission

6.7 Summary

In summary, there are many tools available for assessing postoperative pain in children. Clinicians need to use tools that are reliable, valid, and easy to use. Many of the tools are designed to capture pain intensity, which is only one part of a comprehensive pain assessment. Figure 6.9 and the following tables summarize current tools for assessing pain in children of different age groups. Table 6.1 addresses tools for use in neonates, Table 6.2 addresses behavioral tools, and Table 6.3 addresses self-report tools. Whichever tool is chosen for use, it must be used regularly to effectively manage postoperative pain in children.

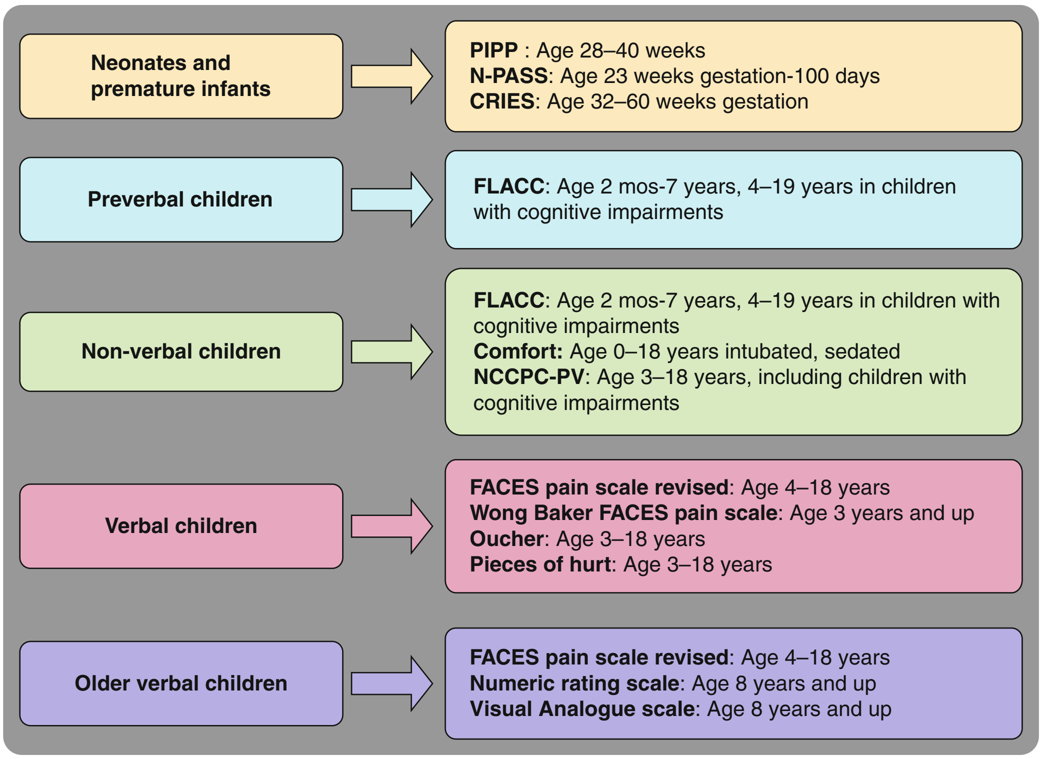

Fig. 6.9 Appropriate pain assessment scales for children of different age groups (See text for details)

Table 6.2 Behavioral pain assessment tools

Tool	Reference	Age range	Clinical indications for use	Guidelines for use	Advantages and disadvantages
FLACC	Merkel et al. [29]	2 months–7 years; ages 4–19 years for children with cognitive impairments	Postoperative pain	Scoring ranges from 0 to 2 in each of the 5 indicators for a total score of 0–10	Child needs to be observed for a minimum of 2 min while awake, 5 min while asleep. Five behavioral indicators
COMFORT	Ambuel et al. [44]	0–18 years	Postoperative pain	8 categories with scores for each of 1–5. Scoring between 8 and 40. Score determines optimal sedation in child	Multidimensional; 8 indicators, including six behavioral and two physiological. Requires extensive training. Only tool validated for use in intubated sedated children
NCCPC-PV	Breau et al. [47]	Children ages 3–18 years who are able to provide a verbal report including children with cognitive impairments	Postoperative pain	6 categories with indicators for a total of 27 indicators. Scores 0–3 or not applicable for each indicator scores are tabulated. A score of 11 or more is indicative of moderate to severe pain; a score of 6–10 is indicative of mild pain	Requires a 10-min observation time. More comprehensive than FLACC in that it includes five behavioral indicators and one physiological. Includes cutoff scores

Table 6.3 Self-reporting pain assessment tools

Tool	Reference	Age range	Clinical indications for use	Guidelines for use	Advantages and disadvantages
Faces Pain Scale-Revised	Hicks et al. [35]	4–18 years	Postoperative pain, acute procedural pain	Series of 6 faces depicting “no pain” to “most pain possible.” Scoring 0–10	Simple, easy to use and explain. Translated into 32 languages and available on the Internet, although not all translations have been validated
Wong-Baker FACES Pain Scale	Wong and Baker [39]	3 years and older	Postoperative pain, procedural pain	Series of six faces ranging from smiling to crying. Scoring 0–5	Simple, easy to use, and readily available. Children have demonstrated a tendency to choose the anchors; may measure pain affect rather than pain intensity
Numeric rating scale	von Baeyer et al. [36]	8–18 years	Postoperative pain, procedural pain	11-point scale with 0 = no pain and 10 = most pain	Easy and quick to use. Does not require tools. Can be explained verbally
Visual analogue scale	Huskisson [42]	8 years and older	Procedural pain	Premeasured horizontal or vertical line, usually 100 mm in length. Child indicates pain intensity by marking a point along the line	Easy and quick to use. Limited clinical utility: difficult to interpret and document; requires careful explanation. Variability in length of line, use of marking, and choice of anchor words
Oucher	Beyer and Aradine [37]	3–18 years	Postoperative pain, procedural pain	Two scales; a series of 6 photographic faces and a 0–100-mm vertical numeric scale	Expensive (must be printed in color). Children should be screened to determine their ability to use the numeric rating scale
Pieces of Hurt	Hester [38]	3–18 years	Procedural pain	Four red plastic poker chips representing “little hurt” to “most hurt you could have.” Child chooses the chip that represents his/her pain intensity. Scoring 0–4	Need to have poker chips. Infection control (cannot be used between patients); need to store chips at the bedside

6.8 Developmental, Familial, and Psychological Factors

6.8.1 Age

Historically, some have been tempted to erroneously conceptualize children as "mini-adults" when it came to formulating practice guidelines. It is now clear that many aspects of children's behavior are unique and dissimilar to corresponding behavior in adults. Age-related developmental changes interact with many factors that influence pain assessment. The effects of age in the context of pain assessment have been increasingly studied over the past 20 years. Some of these effects are clear and some are more subtle.

One of the most obvious and pertinent factors relevant to assessing a child's pain is the level of the child's ability to communicate the experience of pain. While self-report is the gold standard for pain assessment [49], this is often difficult or impossible for young children or for children with developmental delays. Further, as pain is by nature a subjective experience, reporting something as complex as one's pain experience is inherently challenging [50]. In addition to possible limitations in communicating information about pain being experienced, what a developing child understands when questioned about pain or the child's understanding of how to respond using pain assessment tools can be limited or qualitatively different from what the assessing adult understands. These differences can be a result of a number of factors including the child's level of communication sophistication, past pain experiences, and culture. Furthermore, a child who is ill and/or in pain may have more difficulty engaging effectively in tasks, particularly if those tasks are complex.

Neonates and Infants

There is considerable evidence from biological measures that newborns and infants experience pain at the same level of intensity as adults [51]. There is strong evidence from the use of physiological and behavioral measures that infants show enhanced acute pain responses [52]. It has long been known that as the number of painful procedures that a neonate or infant experiences increases, there can be a corresponding increase in anticipatory fear reactions related to cues for an upcoming medical procedure [53]. Obviously, given the very limited ability of an infant to communicate, physiological, biological, and observational measures must be relied upon to assess pain in very young children. In many cases, parents can provide valuable information based on behavioral observations of an infant that can be valid and reliable estimates of pain and distress.

Preschoolers

Preschool age children present with some remarkable abilities but also experience considerable challenges in many cases when trying to rate their pain. As children develop and as new skills are acquired in cognitive, motor, and social domains, new abilities emerge. Along with these abilities come unique response tendencies that correspond with a child's developmental stage. For example, it has been found that younger children tend to assign higher intensity scores to pain descriptors than older children [54]. It has also been noted that as cognitive skills such as seriation, classification, matching, and estimation develop, children are able to more reliably produce valid pain scores. The younger a child is, the greater the tendency that a child will be more egocentric and concrete and focus excessively on perceptually salient aspects of a scale [55]. Younger children such as those in the 3–4-year age range have been found to be more likely to choose endpoints of visual analogue or categorical scales [56]. It is also important to note that a child's ability to attend to and complete tasks such as pain ratings is affected by stressors [57]. This is particularly pertinent given the stressful nature of pain. As well, there also appears to be a strong developmental trend with regard to a child's ability to use words that label one's emotional state [58]. As a child's language skills become more sophisticated, his/her ability to provide valid and reliable pain reports also increases.

School-Age Children

As with the previously described age groups, as children in this age category develop, they become increasingly able to use language and conceptual thinking to more skillfully provide information related to pain assessment. It is during this developmental stage that children show increasing abilities to use many self-report scales. During this stage, children tend to use more complex conceptualizations and report more abstract and affective aspects of pain [4]. This ability can be noted between ages 7 and 10 years, becoming more established by the age of 11 years [59]. A wider range of self-report measures can be reliably used to obtain valid pain measures in this age range.

Adolescence

Adolescents show an increasing ability to describe and focus on the psychological and social impact of pain. Adolescents generally demonstrate increased cognitive flexibility, abstract thinking, and a broader vocabulary available to describe their experiences. They also tend to show increased concern about the personal and future relevance of a current pain experience as it pertains to disability and disfigurement [4].

6.8.2 Developmental Delays

Relevant to the discussion of a child's ability to report pain and an observer's ability to rate a child's pain is a discussion on unique challenges that exist when assessing pain in children with developmental delays or other forms of physical or mental impairment. Individuals with developmental disabilities are at risk of having their pain underestimated and undertreated due to their difficulties in verbal communication, cognitive impairment, and even motor skill deficits [60]. Malviya and colleagues found that few developmentally delayed children with postoperative pain were assessed for pain, and those who were assessed tended to receive fewer doses of analgesic medication [61]. This bias may be rooted in an incorrect belief that developmentally disabled children experience less pain or have higher pain tolerances [62]. Strong evidence exists that it is more likely that differences in apparent pain tolerance or pain behaviors are a result of differences in behavioral expression of pain [63]. This is especially pertinent as children in this population can be more likely to experience more frequent and particularly painful medical procedures due to other physical conditions [64, 65].

As is the case with very young children, parents and other caregivers who are familiar with a child with developmental disabilities have the potential to provide valuable and valid estimates of the child's pain experience. This information may simply not be measurable using existing pain assessment tools available in most hospital settings [64]. However, even caregiver reports have been found to be inconsistent and underestimate pain in this population [66, 67]. Fortunately, there is a growing body of research that has examined pain measurement in the developmentally disabled. There is evidence that observers, even those unfamiliar with a developmentally delayed child, can reliably assess pain in these children when provided with adequate information about the child in conjunction with the use of validated assessment measures [64].

6.8.3 Psychological Factors

Expectations

Assessing both a child's and parents' expectations with regard to the anticipated procedure can be a helpful aspect of pain assessment. An important part of understanding a child's expectations of pain is obtaining a history of the child's experience with previous painful procedures. Children who have experienced multiple previous painful procedures, particularly those who have received poor analgesia during those procedures, are at increased risk of developing higher levels of procedure- and pain-related anxiety [68]. This can lead to a vicious cycle where pain and anxiety amplify each other and thereby lead to heightened pain experience and pain behavior.

The impact of expectations on pain perception has been broadly established [69]. Cheng et al. reported that pain expectation, previous pain experience, and acceptance of pain accounted for 55 % of the variance in children's overall pain levels [70]. It has been found that children are prone to having difficulty in accurately estimating the amount of pain that they will experience [71]. Expectations related to a painful stimulus have been found to be associated with later pain ratings following a painful episode [72]. A subsequent study found that children who expected to have more pain postoperatively tended to report higher pain levels [73]. Of note, it has also been found that health-care providers can unintentionally affect an individual's perception of pain by doing such things as communicating personal expectations [74]. This highlights the importance of the care provider's approach to pain assessment and management while interacting with a child.

Anxiety, Fear of Pain, and Catastrophizing

Effective pain assessment includes an understanding of factors related to procedural and pain-related anxiety and fear. Pain-related fear and anxiety are natural and understandable consequences of pain and anticipating a painful procedure. It is important to understand that it can be difficult for children to separate their reactions to pain from their reactions to fear and anxiety [18]. However, this should not be used by clinicians as an excuse to deny appropriate analgesia due to a supposition that reported pain is psychosomatic or merely a manifestation of fear.

Anxiety has been established as a factor that can amplify one's pain experience [75]. Tsao and colleagues found that anxiety symptoms, anticipatory anxiety, and anxiety sensitivity accounted for 62 % of the variance when predicting a child's pain response to experimental pain [76]. Another study also found that pain catastrophizing predicts children's pain ratings for experimental pain [77]. An interesting study of postoperative pain in adolescents found that preoperative anxiety and anticipated pain levels predicted postoperative pain ratings and analgesic use [78]. These studies highlight some of the effects of pain-related anxiety and pain catastrophizing on pain. They emphasize the impact of anxiety and fear of pain on a child's perception of pain and should not be misinterpreted to suggest that appropriate analgesia should not be provided. Perception is reality for anyone experiencing pain, and assessing pain and pain-related anxiety effectively enables health-care providers to better understand and adequately manage pain.

Social and Family Factors

Understanding a child's family context is an obvious key factor in understanding a child's pain experience [79]. Children can be at risk for inaccurate assessment and poor pain management due to social and family factors. Accurate parental reports can play an important role in a child's care, putting a child at risk if those reports are not valid. Potential barriers include a parent's inability to accurately assess pain, parental fears regarding negative side effects of treatment, and inaccurate beliefs about the risk of addiction to analgesics [80, 81].

Palermo and Chambers have written an excellent review on important family variables relevant to pain assessment to take into account at the levels of the individual child, dyadic factors, and the family itself [13]. Working collaboratively with family members while using validated pain assessment tools has been found to result in effective pain assessment [47].

Schecter and colleagues found that parents' prediction of a child's pain response was the best predictor of distress during immunization, highlighting the potential value of parental input during pain assessment [82]. In addition, parents generally expect that their children's procedural pain be appropriately managed [83] and are therefore often highly motivated to assist health-care providers as needed during pain assessment.

Biases in Health-Care Providers

There is a rich collection of literature that clearly demonstrates humans' inherent tendency to individual bias. For example, a dated but relevant study found that physicians were biased to overestimate a child's cognitive level if the child is well dressed and does not have dysmorphic features [84]. There are a number of important issues that are worth noting for individuals involved in the medical care of children who experience pain due to disease and/or medical procedures.

A primary ongoing issue in pediatric pain assessment and management is the reluctance of some health-care providers to use analgesics (particularly opioids) to manage pain. Some of these biases result from misinformation based on outdated or biased perceptions [85]. Such biases can lead care providers to minimize pain when assessing it and attribute pain to other factors such as anxiety or other psychological factors. While it has been well established that stress and anxiety can exacerbate pain perception and pain behavior and impede pain coping [86, 87], a reluctance to use opioids or other analgesics according to established guidelines is unethical and inhumane.

In a survey of physicians across a variety of subspecialties, it was found that pediatricians tended to report a belief that pain was experienced at an earlier age than surgeons and family practitioners and were more likely to prescribe analgesics for pain than these other groups [88]. That same study also found that physicians tended to rate other subspecialty procedures as more painful than procedures from their own specialty. Another research found that physicians were far more likely to prescribe appropriate analgesics for the same medical problem in older patients compared to toddlers [89]. While these studies highlight physician bias in practice, these biases exist across specialties and disciplines. Awareness of one's own personal biases must be a priority for all care providers when assessing and managing a child's pain.

6.8.4 Gender

There have been a number of studies investigating the differences in pain response related to sex (physiological factors) and gender (psychosocial factors) in children. Several studies aimed at measuring relationships between sex and pain reactions have failed to observe any differences between boys and girls [90–92]. Other findings suggest that there are biological differences in ways males and females react to pain across the life span. For example, several researchers conclude that females have lower pain threshold and tolerances than males [93–95]. Sex differences in pain responses in adults have also been attributed to various biological differences in pain mechanisms, such as brain chemistry, metabolism, physical structures, and hormonal variations affecting pain transmission, pain sensitivity, and pain perception [94, 96]. Unfortunately, these findings are inconsistent in the pediatric population [97].

Further research on this subject has investigated gender-related differences, including pain behavior and characteristics influenced by sociocultural factors such as femininity and masculinity [98]. In these studies, females have commonly been found to report more severe levels of pain, more frequent pain, and pain of longer duration than males [96, 99, 100]. In addition, girls of various ages have been found to rate a greater difference between their ratings of unpleasantness of pain and pain intensity scores in comparison to boys, indicating that females may have a greater ability to discriminate different pain stimuli [101–103]. When analyzing these findings, it is essential to consider that differences in pain responses between genders could be attributed to differences in pain reporting styles. In multiple studies, girls consistently select more words to describe their pain than boys [54], which corresponds with findings suggesting greater verbal fluency and emotional expressiveness in girls.

While increased pain reactions and behaviors may be observed in females, this does not necessarily imply that they are experiencing more pain. It is possible that they could simply be more verbally expressive about their pain than males, which can be attributable to psychosocial factors [104]. Stereotypically, males in many cultures are expected to hold back on reporting pain. As a result there may be a greater social cost to openly express their experience of pain. This may teach boys to minimize pain responses, which in turn can lead society to expect less pain response from them. In some cultures, females are perceived to be weaker and to tolerate less pain, which invites them to express their pain more freely [105]. In a recent study on sex differences in parent and child pain ratings, researchers found that, although subjects of both genders correspondingly responded to pain in the presence of both parents, fathers were inclined to rate a higher pain score to their sons than daughters [106], which illustrates a societal expectation that may falsely contribute to differences observed in gender reactions to pain. Due to the inconsistency in the literature, it is important to consider the many factors that may influence pain responses and the various ways these can be interpreted when assessing a child's pain.

6.8.5 Cultural Factors

It is important to be aware of cultural factors and possible cultural stereotypes that can exist when assessing procedural pain in children. It is also important to note that subjective experience and coping strategies in response to pain in children can be unique across cultures. As well, some cultures conceptualize pain as positive, character building, or cleansing and welcome painful experiences for these and other reasons.

Studies that have examined pain in children from different cultures have shown some consistent findings. For example, differences have been found between children from cultural groups in their pain control and pain behaviors, but not in self-reported pain scores [107, 108]. Pfefferbaum and colleagues (1990) have noted that these differences may reflect biased descriptors included in observational instruments, which fail to capture pain behaviors unique to certain cultures [109]. Other findings suggest that self-report measures can accurately assess a child's level of pain regardless of his/her cultural background [110]. Gharaibeh and Abu-Saad (2002) argue that children have their own separate subculture mediated by common norms of growth and development, natural feelings and instinct, and common styles of nonverbal communication [110]. This line of thought supports the universal pain experience in children as mediated more by developmental maturation than by culture.

To maximize accurate assessment of children's pain that is also culturally sensitive, recent pediatric literature highlights the benefit of self-report measures [111, 112]. The researchers from these studies took Westernized self-report assessment tools, such as the Wong-Baker FACES Scale and Oucher Scale, and created new ethnic versions of these tools for a variety of cultures (African-American, Hispanic, and Lebanese). It is also worth noting that some original Western self-report assessment tools, including the Wong-Baker FACES Scale and Poker Chip Scale, were found to be reliable and appropriate for Jordanian-Muslim children between the ages of 3 and 14 [110]. In general, the new ethnic versions of each assessment tool achieved good correlations with existing reliable measures of pain, providing support for the use of these scales. As well, it was suggested that these culturally sensitive self-report measures foster a sense of respect between the medical team and patient's family, opening further communication that may help break down stereotypical barriers.

Conclusion

This chapter has reviewed current practice standards in assessing pain in children with a focus on practice relevant to regional anesthesia. Great progress has been made in the past 25 years in the field of pain assessment in children. However, it is also clear that a dearth of information exists on pain assessment specifically relevant to regional anesthesia.

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