



Assessment and treatment of postoperative pain in children

Dmytro Dmytriiev, MD, PhD

ABSTRACT

Associate Professor,
Department of Anesthesiology
and Intensive Care, Vinnitsya
National Medical University,
Vinnitsya, Vinnits'ka Oblast
(Ukraine)

Correspondence:

Dmytro Dmytriiev, MD,
PhD, Associate Professor,
Department of Anesthesiology
and Intensive Care, Vinnitsya
National Medical University,
Pyrohova St, 56, Vinnitsya,
Vinnits'ka Oblast, Ukraine,
21000;
E-mail: dmytro.dmytriiev@gmail.
com, <http://orcid.org/0000-0001-6067-681X>

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Management of postoperative pain in children being under-recognized and as a result undertreated for the long period of time. Use of the precise and valid methods for the pain assessment in children is necessary for the following pain management.

Articles in English on the corresponding theme were reviewed (literature search for the period from 1978 to 2018 in PubMed, EMBASE, Cochrane, and Google Scholar). Data from 39 articles were used, key statements of these were synthesized and described in this article.

The latest methods of pain assessment have been described and summarized in this article depending on the age of a child and his/her status of consciousness and ventilation. Different scales utilize different information for the pain assessment, but the validity of them was shown in the studies. All these methods should be used in routine clinical practice and guide the pain management throughout the patient's stay in the hospital.

In a large prospective study it was shown that the pain level depends not only on the volume of trauma after the operation, but also the localization and character of procedure, so even more traumatic operation can cause more pain. That shows a relevance of the pain management according to the score of different pain scales.

We also tried to utilize in tables recent data from guidelines on the pain management in children and group them according to the level of postoperative pain.

Key words: Pain, Postoperative; Pain, Assessment; Children; Pain management.

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INTRODUCTION

Pain is a feeling, which motivates person to avoid damaging situations and protect impaired tissues during healing process. According to the International Association for the Study of Pain (IASP): pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.¹ Adequate control of postoperative pain is not reached in more than 80% of patients in US, which depends on the performed operation, used analgesic methods. Inappropriate control of postoperative pain is associated with an increased morbidity, decreased function and quality of life, prolonged time of recovery, and longer opioid

use.²

Postoperative pain in children has been a problem for a long time, as it is often undertreated due to a variety of reasons such as different reactions on noxious stimuli, focusing on the cause but not the symptom, so pain remains under treated. Many children receive inadequate pain management, so pain becomes chronic in 20% of cases.³ So, precise tools for the assessment of pain in different age categories are very important in order to choose appropriate intervention for the pain management.

We reviewed articles in English on the corresponding theme (literature search for the period from 1978 to 2018 in PubMed, EMBASE, Cochrane, Google

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Scholar). Data from 39 articles were used, key statements of them were synthesized and described in this article.

Precise pain assessment is very important in the pain management, as it allows choosing interventions according to the pain level. Different methods and scales have been used in children, which depend on the age and ability to self-report their feelings.

ABCs of pain management were recommended by the Agency for Health Care Policy and Research (AHCPR), which include the following statements:

- A. Ask about pain regularly. Assess pain systematically.
- B. Believe the patient and family in their reports of pain and what relieves it.
- C. Choose pain control options appropriate for the patient, family, and setting.
- D. Deliver interventions in a timely, logical, coordinated fashion.
- E. Empower patients and their families. Enable patients to control their course to the greatest extent possible.¹²

The following scales can be used in neonates and preverbal children for the assessment of postoperative pain:

- CRIES scale;
- COMFORT scale;
- CHEOPS;
- FLACC.

CRIES scale stands for Crying, Requires oxygen, Increased vital signs from baseline, Expression, Sleeplessness. It can be used from birth till the age of 6 months, having score from 0 to 10, where score above 4 requires additional analgesic support.⁴ This scale is represented in Table 1.

COMFORT scale includes 6 behavioral items such as alertness, calmness, muscle tone, movement, facial tension, respiratory response for ventilated/ crying for nonventilated and 2 physiological items such as heart rate and mean arterial blood pressure. It can be used at the age till 3 years for the assessment of postoperative and

procedural pain.^{5,6} COMFORT scale is represented in the Table 2.⁵

CHEOPS (Children's Hospital of Eastern Ontario Pain Scale) scale is a behavioral scale for the assessment of postoperative pain in young children. It includes the following parameters as cry, facial, child verbal, torso, touch, legs.⁷ It can be used in children from 0 to 4 years.⁸ CHEOPS score ranges from 4 to 13, and additional interventions are required for the score above 6. CHEOPS is represented in the Table 3.

FLACC (Face, Leg, Activity, Cry, and Consolability) tool can be used for the assessment of postoperative and periprocedural pain in children from 2 months to 7 years. It is represented in the Table 4.⁹

Children's and Infant's Postoperative Pain Scale (CHIPPS) is used for the assessment of postoperative pain in children from 0 to 5 years, where scores between 0 and 3 indicate the pain absence, and scores above 4 indicate a need for pain management. This scale is represented in the Table 5.¹⁰

Neonatal Infant Pain Scale (NIPS) is used for the pain assessment in neonates. It includes facial expression, cry, breathing pattern, arms, legs, state of arousal, heart rate and O₂ saturation. Score from 0 to 3 indicate absence or mild pain, 4-6 – moderate, 7-10 – severe. This scale is represented in the Table 6.¹¹

The most reliable indicator of pain is self-report by the patient, which is usually possible in children older than 4 years. At this age different pain rating scales can be used including the following:

- Wong-Baker FACES scale
- Faces scale of Bieri
- OUCHER Scale of Beyer and Wells
- Visual analog scale
- Verbal rating scale

Table 1: CRIES scale for the postoperative pain assessment in neonates.⁴

Parameter	0	1	2
Crying	No	High pitched	Inconsolable
Requires O ₂ for Sat > 95	No	< 30%	30%
Increased vital signs	HR and BP + or < than preoperative	HR or BP increased < 20% than preoperative	HR or BP increased > 20% than preoperative
Expression	None	Grimace	Grimace/Grunt
Sleepless	No	Wakes at frequent intervals	Constantly awake

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Table 2: COMFORT scale for the assessment on postoperative and procedural pain

Parameter	Assessment	Score
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/her eyes frequently, less responsive to the environment)	3
	• Awake and alert (child responsive to the environment)	4
	• Awake and hyper-alert (exaggerated responses to environmental stimuli)	5
Calmness/Agitation	• Calm (child appears serene and tranquil)	1
	• Slightly anxious (child shows slight anxiety)	2
	• Anxious (child appears agitated but remains in control)	3
	• Very anxious (child appears very agitated, just able to control)	4
	• Panicky (severe distress 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
	• Actively breathes against ventilator or coughs regularly	4
	• Fights ventilator	5
Crying	• Quiet breathing, no crying sounds	1
	• Occasional sobbing or moaning	2
	• Whining (monotonous sound)	3
	• Crying	4
	• Screaming or shrieking	5
Physical movement	• No movement	1
	• Occasional (three or fewer) slight movements	2
	• Frequent, (more than three) slight movements	3
	• Vigorous movements limited to extremities	4
	• Vigorous movement including torso 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 toes	4
	• Extreme muscle rigidity and flexion of fingers and toes	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 muscles contorted and grimacing	5

Table 3: CHEOPS for the pain assessment in young children

Parameter	Assessment	Score
Cry	• no cry	1
	• moaning	2
	• crying	2
	• screaming	3
Facial	• smiling	0
	• composed	1
	• grimace	2
Child verbal	• positive	0
	• none	1
	• complaints other than pain	1
	• pain complaints	2
Torso	• both pain and non-pain complaints	2
	• neutral	1
	• shifting	2
	• tense	2
	• shivering	2
	• upright	2
Touch	• restrained	2
	• not touching	1
	• reach	2
	• touch	2
	• grab	2
	• restrained	2
Legs	• neutral	1
	• squirming kicking	2
	• drawn up tensed	2
	• standing	2
	• restrained	2

Table 4: FLACC tool for the postoperative and periprocedural pain assessment

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.

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Table 5: CHIPPS for the postoperative pain assessment

Item	Structure	Points
Crying	• None	0
	• Moaning	1
	• Screaming	2
Facial expression	• Relaxed/smiling	0
	• Wry mouth	1
	• Grimace (mouth and eyes)	2
Posture of the trunk	• Neutral	0
	• Variable	1
	• Rear up	2
Posture of the legs	• Neutral, released	0
	• Kicking about	1
	• Tightened	2
Motor restlessness	• None	0
	• Moderate	1
	• Restless	2

Table 6: Neonatal Infant Pain Scale

Variable	Finding	Points
Facial expression	• Relaxed (restful face, neutral expression)	0
	• Grimace (tight facial muscles, furrowed brow, chin, jaw)	1
Cry	• No cry (quiet, not crying)	0
	• Whimper (mild moaning, intermittent)	1
	• Vigorous crying (loud scream, shrill, continuous. If infant is intubated, score silent cry based on facial movement)	2
Breathing pattern	• Relaxed (usual pattern for this infant)	0
	• Change in breathing (irregular, faster than usual, gagging, breath holding)	1
Arms	• Relaxed (no muscular rigidity, occasional random movements of arms)	0
	• Flexed/extended (tense, straight arms, rigid and/or rapid extension, flexion)	1
Legs	• Relaxed (no muscular rigidity, occasional random leg movements)	0
	• Flexed/extended (tense, straight legs, rigid and/or rapid extension, flexion)	1
State of arousal	• Sleeping/awake (quiet, peaceful, sleeping or alert and settled)	0
	• Fussy (alert, restless and thrashing)	1
Heart rate	• Within 10% of baseline	0
	• 11-20% of baseline	1
	• >20% of baseline	2
O2 saturation	• No additional O2 needed to maintain O2 saturation	0
	• Additional O2 required to maintain O2 saturation	1

Wong-Baker FACES scale can be used in children from 3 years of age for the assessment of postoperative, perioperative pain. Training is necessary for use of

Table 7: Behavioral Pain Scale

Variable	Finding	Point
Facial expression	• Relaxed	1
	• Partially tightened (e.g., brow lowering)	2
	• Fully tightened (e.g., eyelid closing)	3
	• Grimacing	4
Upper limb movements	• No movement	1
	• Partially bent	2
	• Fully bent with finger flexion	3
	• Permanently retracted	4
Compliance with mechanical ventilation	• Tolerating movement	1
	• Coughing but tolerating ventilation for most of the time	2
	• Fighting ventilator	3
	• Unable to control ventilation	4

Table 8: Critical Care Pain Observation Tool

Variable	Finding	Point
INTUBATED		
Compliance with ventilator	• Tolerating ventilator or movement	0
	• Coughing but tolerating	1
	• Fighting ventilator	2
NOT INTUBATED		
Vocalization	• Talking in normal tone or no sound	0
	• Sighing, moaning	1
	• Crying out, sobbing	2
Facial expression	• Relaxed, neutral	0
	• Tense	1
	• Grimacing	2
Body movements	• Absence of movements	0
	• Protection	1
	• Restlessness	2
Muscle tension	• Relaxed	0
	• Tense, rigid	1
	• Very tense or rigid	2

this scale. Explanation to a child should be provided, so he/she understands that face 0 is very happy, because there is no pain, and Face 5 represents the strongest pain the child can imagine. Wong-Baker FACES scale is represented at Figure 1.¹³

Faces Pain Scale by Bieri is also used for the postoperative pain assessment in children older than 5 years. Training is necessary before using this scale. Faces Pain Scale by Bieri is represented at Figure 2.

OUCHER Scale of Beyer and Wells can be used in children above 3 years. Training of the child is also necessary before performing an assessment. OUCHER Scale of Beyer and Wells is represented in Figure 3.¹⁴

Different verbal report scales have also been used. There are 4-point¹⁵ to 15-point scales,¹⁶ which include



Figure 1: Wong-Baker FACES scale



Figure 2: Faces Pain Scale by Bieri

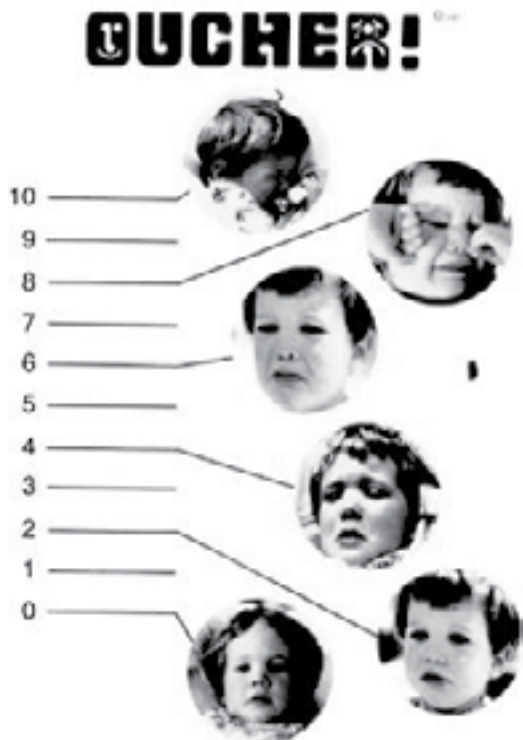


Figure 3: OUCHER Scale of Beyer and Wells

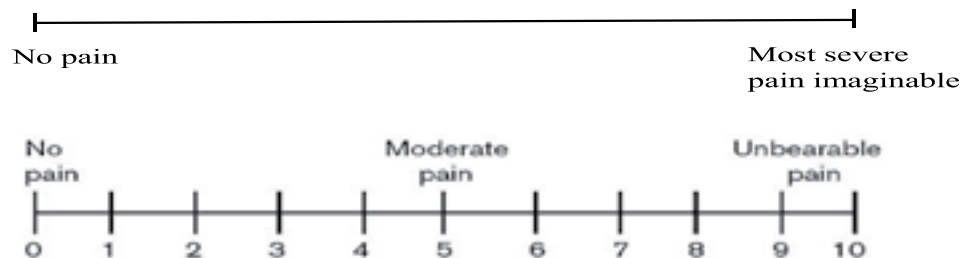


Figure 4: Visual analog scale (VAS) and numeric pain scale

different adjectives for describing pain from mild to severe.

Visual analog scale (VAS) is usually a 100-mm long horizontal line, which has labels of 'No pain' near one end and 'Most severe pain imaginable' at the other end, which requires from patient an ability to compare their pain sensation with the length of the line. Different scales are available online and one of them is represented at Figure 4.

Another way of postoperative pain assessment in children is Parent's Postoperative Pain Measure (PPPM), which can be used in children from 2 years. It includes 15 questions about child's behavior and activity. An answer for each question provides 1 score up to a maximum of 15. A score of 6 and more indicates clinically relevant pain.¹⁷

Unconscious or Sedated Patients

Pain assessment is a real problem in unconscious or sedated patients. For this purpose several methods have been described:

1. Behavioral Pain Scale (BPS).
2. Critical Care Pain Observation Tool (CPOT).
3. Nonverbal Pain Scale (NVPS).

BPS can be used for pain assessment in intubated patients. This scale can assess pain using body language. Scores of ≤ 3 and less indicates no pain, 4-5 – mild pain, 6-11 indicate an unacceptable amount of pain, 12 – maximum pain; analgesia should be considered at scores 6 and higher. BPS is represented in the Table 7.^{18,19}

CPOT can be used for pain assessment in intubated and sedated patients based on facial expression, muscle tension and movement, compliance with

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Table 9: Nonverbal Pain Scale

Variable	Finding	Point
Face	• No particular expression or smile	0
	• Occasional grimace, tearing, frowning, wrinkled forehead	1
	• Frequent grimace, tearing, frowning, wrinkled forehead	2
Activity (movement)	• Lying quietly, normal position	0
	• Seeking attention through movement or slow, cautious movement	1
	• Restless, excessive activity and/or withdrawal reflexes	2
Guarding	• Lying quietly, no positioning of hands over areas of the body	0
	• Splinting areas of the body, tense	1
	• Rigid, stiff	2
Physiology (vital signs)	• Baseline vital signs unchanged	0
	• Change in SBP >20 mmHg or HR >20 bpm	1
	• Change in SBP >30 mmHg or HR >25 bpm	2
Respiratory	• Baseline RR / SpO2 synchronous with ventilator	0
	• RR >10 bpm over baseline, 5% decrease SpO2 or mild ventilator asynchrony	1
	• RR >20 bpm over baseline, 10% decrease SpO2 or severe ventilator asynchrony	2

ventilated breaths for intubated patients or vocalized pain in non-intubated patients. CPOT score of 2 and less indicates no or mild pain, scores above 2 indicates unacceptable level of pain, so further or alternative methods of analgesia should be considered. CPOT is represented at the Table 8.²⁰

NPS is used for pain assessment in nonverbal and intubated patients. It assesses facial expression, movements, guarding, vital signs, changes in respiration. Scores of ≤ 2 indicate no pain, 3-6 – moderate pain, ≥ 6 – severe pain; analgesia is required if score is 3 or higher. This scale is represented in the Table 9.²¹

MANAGEMENT:

The next step after the pain has been assessed and measured is treatment. Different approaches have been used in the provision of sufficient level of analgesia in the postoperative period depending on the intensity of pain the patient has. There was one big prospective study conducted, where the patients were asked to quantify their pain after 179 different surgical interventions.²² So that pain management should be based not only on the level of trauma after the operation, but also the intensity of pain that they experienced.

Table 10: Pain management for less painful operations

Levels	Intraoperative	Postoperative
Basic level	• Rectal NSAID or if not available rectal paracetamol. ^{24,25}	• IV fentanyl or morphine • Oral NSAIDs and/or oral paracetamol in adequate dosing during the entire postoperative period. ^{24,25}
Intermediate level	• Rectal NSAID or if not available rectal paracetamol	• IV fentanyl or morphine • IV nalbuphine. ²⁹ • Oral NSAIDs and/or paracetamol in adequate dosing during the entire postoperative period
Advanced level	• IV ketorolac (if available) or rectal NSAID. ²⁶ • IV loading dose of paracetamol. ²⁷	• IV fentanyl or morphine • Oral NSAIDs and/or paracetamol in adequate dosing during the entire postoperative period

Table 11: Pain management of moderately painful operations

Levels	Intraoperative	Postoperative
Basic level	• Rectal NSAID or if not available rectal paracetamol. ^{24,25}	• IV fentanyl or morphine • Oral NSAIDs and/or oral paracetamol in adequate dosing during the entire postoperative period. ^{24,25}
Intermediate level	• Rectal NSAID or if not available rectal paracetamol • Caudal blockade with long-acting local anesthetics w or w/o clonidine if available. ³⁰	• IV fentanyl or morphine • IV nalbuphine. ²⁹ • Oral NSAIDs and/or paracetamol in adequate dosing during the entire postoperative period
Advanced level	• IV ketorolac (if available) or rectal NSAID. ²⁶ • IV loading dose of paracetamol. ²⁷ • Ultrasound-guided peripheral blocks, TAP, paravertebral or ultrasound-guided caudal blocked with long-acting local anesthetics combined with appropriate adjunct). ³¹⁻³³	• IV fentanyl or morphine • IV nalbuphine • Oral NSAIDs and/or paracetamol in adequate dosing during the entire postoperative period

The less painful surgeries were: excision of solitary lymph nodes (cervical), prepuce surgery, skull and/or brain surgery, and testicular hydrocele surgery. Moderately painful operations were: open umbilical hernia repair, nephrectomy (lap), open inguinal hernia repair; subtotal hysterectomy, spinal canal decompression, and liver resection (atypical, open).

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Table 12: Pain management of severely painful operations

Levels	Intraoperative	Postoperative
Basic level	<ul style="list-style-type: none"> Intravenous fentanyl in divided doses Rectal NSAID or if not available rectal paracetamol after induction of anesthesia or oral paracetamol or NSAID as a part of premedication.³⁴ Local wound infiltration by the surgeon of a long acting local anesthetic.^{35,36} 	<ul style="list-style-type: none"> Intravenous fentanyl or morphine Oral NSAIDs and/or oral paracetamol in adequate dosing during the entire postoperative period.^{24,25} Intravenous or oral tramadol or other suitable agent.³⁷
Intermediate level	<ul style="list-style-type: none"> Intravenous fentanyl in divided doses Rectal NSAID or if not available rectal paracetamol after induction of anesthesia or oral paracetamol or NSAID as a part of premedication.³⁴ Local wound infiltration by the surgeon of a long acting local anesthetic.^{35,36} Loading dose of tramadol or other suitable agent if available: nalbuphine, piritramide before the end of anesthesia. 	<ul style="list-style-type: none"> Intravenous fentanyl or morphine Oral NSAIDs and/or paracetamol in adequate dosing during the entire postoperative period IV or oral tramadol or other suitable agent
Advanced level	<ul style="list-style-type: none"> Intravenous fentanyl in divided doses or remifentanyl infusion Rectal NSAID or if not available rectal paracetamol after induction of anesthesia or oral paracetamol or NSAID as a part of premedication.³⁴ Loading dose of tramadol or other suitable agent if available: nalbuphine, piritramide before the end of anesthesia. 	<ul style="list-style-type: none"> Intravenous fentanyl or other suitable agent IV/oral paracetamol or IV/oral NSAID.³⁸ IV or oral tramadol or other suitable agent Consider patient controlled regional anesthesia or IV-PCA if needed.³⁹

Very painful operations were: incisional hernia repair with alloplastic material, open subtotal hysterectomy, kidney transplantation, open cholecystectomy, tonsillectomy, and complex spinal reconstruction.

For operations, which cause less degree of pain the following measures can be used for the pain management presented in Table 10.²³

For operations, which cause moderate amount of pain the following measures can be used for the pain management, presented in Table 11.²³

For operations, which cause severe pain the following can be used for the pain management, presented in Table 12.²³

CONCLUSION

Pain is an inevitable consequence of surgical interventions in children, which results in a lot of stress and discomfort not only to the patients, but also to their parents. The methods of pain assessment have been described and summarized in this article depending on the age of a child and his/her status of consciousness and ventilation. Different pain measurement tools utilize different information for the pain assessment, but their variable validity has been shown in many of the studies. All available methods should be used in routine clinical practice and guide the pain management throughout the patient's stay in the hospital.

The pain intensity depends not only upon the level of trauma after the operation, but also the localization and character of procedure. So usually more traumatic surgeries cause more pain. That shows a relevance of the pain management according to the score of different pain scales.

We can utilize the recent guidelines for the pain management in children and group them up according to the level of postoperative pain for ready reference.

Conflict of interest: None declared by the author.

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