

## REVIEW ARTICLES

### PREGLJEDNI ČLANCI

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Review article  
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#### POSTOPERATIVE ANALGESIA IN CHILDREN – A COMPREHENSIVE ASSESSMENT AND MANAGEMENT

*POSTOPERATIVNA ANALGEZIJA KOD DECE – SVEOBUHVAŦNA PROCENA I TRETMAN*

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#### Summary

**Introduction.** Pain is the most common cause of complaints in hospitalized pediatric patients. Pain continues to be underestimated and undertreated in childhood. The European Society of Pediatric Anesthetists has published guidelines for pain management in children. **Pain assessment.** Pain assessment is very important in the treatment of pain in children. **Basic pain management.** Administration of basic analgesics is crucial for pain management. **Paracetamol and non-steroidal anti-inflammatory drugs.** Generally, basic or simple analgesia includes the use of paracetamol and non-steroidal anti-inflammatory drugs. **Systemic opioids.** Opioids are reserved for early postoperative and intraoperative use when adequate monitoring and specially trained personnel are available around the clock. **Regional anesthesia and local anesthetics.** Regional anesthesia in children has been increasingly used in recent decades, particularly against the background of multimodal analgesia. **Conclusion.** Basic analgesics are crucial, and opioids are added only when needed. Regional anesthesia and local anesthetics play a superior role in pain management compared to systemic analgesics in such cases in pediatric patients.

**Key words:** Pain; Postoperative Care; Analgesia; Pain Measurement; Child; Anesthesia, Conduction; Anesthesia, Local; Anti-Inflammatory Agents, Non-Steroidal; Analgesics, Opioid

#### Introduction

Pain is an unpleasant sensory and emotional experience associated with potential or actual tissue damage, caused by nociceptive stimuli [1] that can lead to a variety of potentially negative consequences [2]. Pain is triggered in the nociceptors and transmitted to the brain through a cascade of changes in the somatosensory system via appropriate nociceptive pathways. These changes can lead to an increased response to further stimuli and intensify the pain [1]. The most common cause of regret in hospitalized patients is pain

#### Sažetak

**Uvod.** Bol je najčešći uzrok žaljenja hospitalizovanih pedijatrijskih pacijenata. Bol se i dalje potcenjuje i ne leči adekvatno u dečjem uzrastu. Evropsko udruženje pedijatrijskih anesteziologa objavilo je smernice za tretman bola kod dece.

**Procena bola.** Procena bola je veoma važna u lečenju bola kod dece. **Bazični tretman bola.** Primena osnovnih analgetika je ključna za lečenje bolova. **Paracetamol i nesteroidni antiinflamatorni lekovi.** Osnovna ili jednostavna analgezija uključuje upotrebu paracetamola i nesteroidnih antiinflamatornih lekova. **Sistemske opioide.** Opioidi su rezervisani za ranu postoperativnu i intraoperativnu upotrebu kada su adekvatan nadzor i posebno obučeno osoblje na raspolaganju 24 sata dnevno. **Regionalna anestezija i lokalni anestetici.** Regionalna anestezija kod dece se poslednjih decenija sve više primenjuje, posebno na temelju multimodalne analgezije. **Zaključak.** Osnovni analgetici su ključni, opioidni analgetici se dodaju samo u slučaju potrebe. Regionalna anestezija i lokalni anestetici imaju superiornu ulogu u zbrinjavanju bola u odnosu na sistemske analgetike kod pedijatrijskih pacijenata.

**Ključne reči:** bol; postoperativna nega; analgezija; procena bola; dete; regionalna anestezija; lokalna anestezija; NSAID; opioidni analgetici

[3], a reason they seek medical help. It is a subjective experience, so the severity should always be assessed on an individual basis [4]. The pain experienced by children in the hospital can be based on the following pathophysiology: acute, neuropathic, visceral, total, and chronic or persistent pain [5]. Pain in childhood continues to be underestimated and undertreated. The most vulnerable group of patients is infants and neonates in whom analgesic strategies are not used [6, 7]. One of the main difficulties in the treatment of childhood pain is the lack of dissemination of available pain assessment tools [8, 9].

### Abbreviations

FLACC	– Face, Legs, Activity, Cry and Consolability
FPS-R	– Face Pain Scale-Revised
VAS	– Visual Analogue Scale
WHO	– World Health Organization
NSAIDs	– non-steroidal anti-inflammatory drugs
FDA	– Food and Drug Administration

### Pain assessment

Accurate and regular pain assessment is crucial in pain management. Various methods and scales are used to assess pain in childhood [10]. The ABCs of pain management, recommended many years ago by the Agency for Health Care Policy and Research (AHCPR), include the following: A. Ask about pain regularly. Assess pain systematically. B. Believe what the patient and family report about pain and what relieves it. C. Choose pain management options that are appropriate for the patient, family, and environment. D. Implement interventions in a timely, logical and coordinated manner. E. Empower patients and their families. Enable patients to take control [11].

One of the most commonly used scales for pain assessment in children is the Face, Legs, Activity, Cry and Consolability (FLACC) scale [4]. This scale is applicable to children and infants aged two months to seven years without contact with sleeping children (Table 1).

Another frequently used scale for assessing pain in children is the Faces Pain Scale-Revised (FPS-R). This scale utilizes faces arranged in a horizontal row (Figure 1). A face on the left side of a row indicates no pain, while a face on the right side indicates the most severe pain possible [12].

In addition to the FPS-R, the Visual Analogue Scale (VAS) is also employed for school-age children.



Figure 1. Faces Pain Scale-Revised (FPS-R).

Slika 1. Revidirana skala bola prema izrazu lica

This scale consists of a line approximately 10 cm long, with the markings “0” and “10” on opposite sides. The “0” mark signifies no pain and the “10” mark indicates very severe pain (Figure 2) [13, 14].

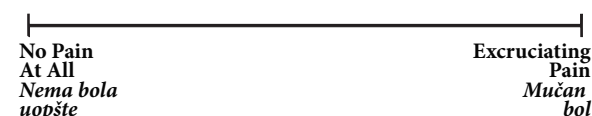
In clinical practice, a numerical rating scale is frequently used to assess pain, especially in school-age and older children. This scale allows the patient to choose a number representing pain intensity or severity. The number zero denotes no pain and the number ten indicates severe pain [4].

### Basic pain management

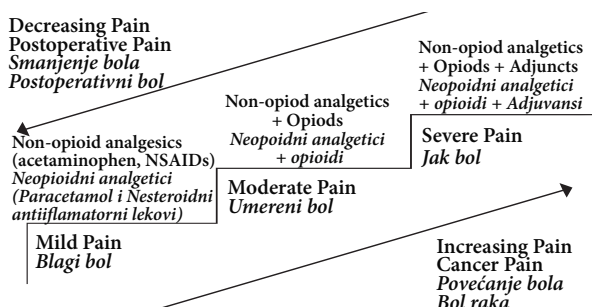
The World Health Organization (WHO) analgesic ladder offers a pain management framework that reflects modern considerations and techniques [15]. The updated WHO analgesic ladder (Figure 3) outlines some changes, including five recommendations for the regular use of analgesics: 1. Oral dosage forms should be used whenever possible; 2. Medications should be administered at regular intervals; 3. Medications should be administered based on pain as assessed by a pain intensity scale; 4. Doses of analgesics should be titrated individually; 5. Caution should be exercised when prescribing analgesics [16].

Table 1. FLACC scale  
Tabela 1. FLACC skala

Category Kategorija	Scoring/Skor		
	0	1	2
Face Lice	No particular expression or smile./Bez poseb-nog izraza ili osmeha.	Occasional grimace or frown, with-drawn, disinterested./Povremena gri-masa ili mrštenje, povučeno, nezain-teresovano.	Frequent to constant frown, clenched jaw, quivering chin. Često do stalno mrštenje, stisnuta vilica, drhtava brada.
Legs Noge	Normal position or relaxes. Normalan položaj ili se opušta.	Uneasy, restless, tense. Nelagodno, nemirno, napeto.	Kicking, or legs drawn up. Šutira, ili povlači noge.
Activity Aktivnost	Lying quietly, normal position, moves easily./Mirno leži, normalan položaj, lako se kreće.	Squirming, shifting back and forth, tense./Migolji se, pomera se napred-nazad, napeto.	Arched, rigid or jerking./Pre-savijeno, ukočeno od trzanja.
Cry Plač	No cry (awake or asleep). Ne plače (budno ili spava).	Moans or whimpers, occasional complaint. Stenje ili cvili, povremeno se žali.	Crying steadily, screams or sobs, frequent complaints. Stalno plače, vrišti ili jeca, često se žali.
Consolability Utešnost	Content, relaxes. Zadovoljno, opušta se.	Reassured by occasional touching, hugging or being talked to, distracti-ble./Umiruje se povremenim dodir-ivanjem, zagrljajem ili razgovorom, ne zadržava pažnju.	Difficult to console. Teško ga je utešiti.



**Figure 2.** Visual Analogue Scale (VAS)  
**Slika 2.** Vizuelno analogna skala (VAS)



**Figure 3.** The World Health Organization pain ladder modified for Acute Pain Management  
**Slika 3.** Izmenjena lestvica bola Svetske zdravstvene organizacije za lečenje akutnog bola

Treating pain in children poses a challenge. Despite ongoing efforts to enhance perioperative pain management in children, many still suffer from perioperative pain in the hospital [17–19].

It is very important for children, irrespective of their age, to receive effective postoperative analgesia. The dosage and type of analgesic should be chosen based on scientific evidence. The administration of basic analgesics (non-steroidal anti-inflammatory drugs or paracetamol) is vital for pain management. These drugs can be administered intravenously, orally, or rectally. The effective use of these basic analgesics significantly influences the reduced use of opioids [20, 21]. Opioids are reserved for early postoperative and intraoperative use when adequate monitoring and specially trained personnel are available around the clock. To enhance pain management efficiency, the Pain Committee of the European Society of Pediatric Anesthesiology (ESPA) published guidelines for pain management in children in 2018, which are globally used [22]. Caution should be exercised when prescribing opioids in patients with obstructive sleep apnea due to the risk of ventilatory dysfunction after the procedure [23]. According to the standards of the American Society of Anesthesiologists (ASA), the use of multimodal analgesia is recommended whenever possible [24]. These standards call for the optimization of acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs) as analgesics, which should be administered at regular intervals rather than as needed [25, 26].

### Paracetamol and non-steroidal anti-inflammatory drugs

This group of medicines contains basic analgesics for postoperative and general pain treatment in both children and adults, intended for managing mild to

moderate pain. Basic or simple analgesia typically involves the use of paracetamol and NSAIDs.

Paracetamol is often combined with opioids for the treatment of more severe postoperative pain. Intravenous formulations are available and prove highly valuable in clinical pediatric practice. Despite its renal toxicity, acetaminophen is considered a safer but weaker analgesic. Infants, neonates, and children, however, have a significant hepatic production of glutathione, and are thus protected against its hepatic toxicity [27, 28]. The most commonly used NSAIDs as basic analgesics are ibuprofen, metamizole, ketorolac and diclofenac [5]. Ibuprofen is a first-choice drug for mild to moderate postoperative pain, often administered orally when feasible, with an analgesic effect almost comparable to that of paracetamol [29]. Another option is metamizole, a potent analgesic, though not globally available worldwide. Ketorolac, which can reduce opioid use, is also widely used potent drug. Diclofenac is daily postoperative pain treatment, more effective than paracetamol and ibuprofen but associated with more side effects. While the usual toxicities in adults are less pronounced in children due to a lack of comorbidities, common side effects of NSAIDs include nephrotoxicity, thrombocytopenia, asthmatic events, gastrointestinal ulceration and, less commonly, hepatotoxicity [30].

### Systemic opioids

Opioids provide excellent pain relief for severe postoperative pain. The World Health Organization recommends the use of opioid analgesics in children experiencing persistent moderate to severe pain in addition to basic analgesia [31]. Morphine remains the gold standard in this group of drugs, although other opioids such as fentanyl and tramadol are also used in clinical practice. Fentanyl is primarily used intraoperatively. In neonates and infants during the first six months of life, there is a risk of developing respiratory arrest and periodic breathing even with small opioid doses. Opioid administration is safer in children over one year of age [32]. Strong opioids such as morphine, fentanyl, remifentanyl and sufentanyl have a high incidence of cardiorespiratory depression. Hence, close monitoring of cardiac and respiratory function is essential when using strong opioids. These opioids reduce the stress response during surgery [33–36]. Tramadol seems to play a key role in the early postoperative management of severe pain due to its fewer adverse effects and minimal cardiorespiratory depression while providing effective analgesia [5]. Studies and the United States Food and Drug Administration (FDA), which may lack scientific bases, reported cases of three children dying after taking opioids in the past 49 years and spoke out against the pediatric use of tramadol. This observation may put children at risk of unrelieved pain and other symptoms by either encouraging physicians to use strong opioids with a higher risk of respiratory depression or avoid opioid use altogether [37].

### Regional anesthesia and local anesthetics

Pediatric regional anesthesia has been increasingly used in recent decades [38], particularly in the context of multimodal analgesia [39, 40]. Neurological complications associated with regional anesthesia in children are very rare. The French-Language Society of Pediatric Anesthesiologists study showed only five transient complications in 31,132 cases of regional anesthesia, with all five patients recovering without serious harm [41]. In 2018, the Pediatric Regional Anesthesia Network (PRAN) reported a study that found no cases of permanent neurological deficits. Out of 10,000 cases of regional anesthesia, only 25 cases resulted in temporary neurological damage [38]. There is an increased potential for neurologic complications in children older than 10 years, in contrast to infants and nonverbal children for whom it was challenging to record sensory deficits [42]. There were no differences in neurologic complications between peripheral nerve blocks and neuraxial anesthesia [43]. In 2018, Suresh et al. analyzed 40,121 cases of pediatric blocks and found that the systemic toxicity of local anesthetics during multiple peripheral nerve blocks was only 0.005%, with no persistent neurological deficits [44]. The European Society of Regional Anesthesia and Pain Management (ESRA) and the American Society of Regional Anesthesia

(ASRA) have published dosage recommendations and guidelines to protect patients from systemic toxicity of local anesthetics [45].

### Conclusion

Inadequate treatment of postoperative pain in children prolongs hospitalization and recovery. Pain should be assessed daily, using instruments and scales appropriate to the patient's age, language, cognitive ability, ethnicity, and type of illness. The most commonly used pain assessment scales for children are the Face, Legs, Activity, Cry and Consolability scale, Face Pain Scale-Revised, Visual Analogue Scale, and the numerical rating scale, depending on the child's age. The administration of basic analgesics is crucial for pain treatment. As a rule, basic or simple analgesia includes the use of paracetamol and non-steroidal anti-inflammatory drugs. Opioids are reserved for early postoperative and intraoperative use when adequate monitoring and specially trained personnel are available around the clock. Regional anesthesia in children has been increasingly used in recent decades, particularly in the context of multimodal analgesia. Regional anesthesia and local anesthetics play a superior role in pain management compared to systemic analgesics in such cases in pediatric patients.

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