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REVİEW

Postoperative Pain in Children

Çocuklarda Postoperatif Ağrı

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ABSTRACT

Postoperative pain is an acute pain that occurs after surgery and decreases over time with the healing of the tissue. The pain perception's mechanism in the pediatric patiens is different and poorly understood. Difficulties in defining and grading pain in pediatric patients also complicate treatment. Postoperative pain treatment in children should be planned with a multidisciplinary and multimodal approach. In this article, it is aimed to review current information on pediatric postoperative pain treatment.

Keywords: pain management, postoperative pain, children

ÖZ

Postoperatif ağrı cerrahi sonrası meydana gelen ve dokunun iyileşmesi ile zamanla azalan bir akut ağrıdır. Pediatrik hastalarda ağrı algılama mekanizması farklıdır ve yeterince anlaşılmamıştır. Pediatrik hastalarda ağrının tanımlanması ve derecelendirmesindeki zorluklar tedaviyi de güçleştirir. Çocuklarda postoperatif ağrı tedavisi multidisipliner ve multimodel bir yaklaşım ile planlanmalıdır. Bu yazıda pediatrik postoperatif ağrı tedavisi hakkında güncel bilgilerin derlenmesi amaçlanmıştır.

Anahtar Kelimeler: ağrı tedavisi, postoperatif ağrı, çocuk

Introduction

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (1). The mechanism of pain perception in the pediatric patiens is complex, diverse and poorly understood. Children are not miniatures of adults. In addition, the belief that babies do not feel pain, do not remember pain or turn into an experience is also wrong. Different phases of their cognitive and physical development will affect how pediatric patiens respond to and interpret pain (2).

In children, focusing on the symptom rather than the cause often results in inadequate treatment, and postoperative acute pain becomes chronic in 20% of cases (3). Untreated postoperative pain increases morbidity, decreases quality of life, prolongs recovery time, and extends the duration of opioid treatment associated with the use of analgesic drugs. Regular and frequent monitoring of pain, providing the appropriate intervention without delay, and ensuring the participation of the child's family in the treatment process increase the success of pain treatment (4-5).

Evaluation of Postoperative Pain in Children

In the treatment of pediatric postoperative pain, it is essential to evaluate the child's response to treatment at frequent and regular intervals (6). Difficulties in defining and grading pain in pediatric patients also complicate treatment. Pain is often difficult to assess in young children because the most widespread symptom of pain is crying, which occurs in many painless situations (7).

Increased heart rate and blood pressure, tachypnea, and decreased oxygen saturation can be considered as physiological indicators of pain. However, it should be kept in mind that these findings may also be seen due to fever, dehydration and some drugs, and even the child's anxiety and fear may cause similar symptoms. Even if the physiological indicators of pain decrease after a while thanks to the adaptation of the body, the pain may still be present. Therefore, physiological parameters should always be used in conjunction with other assessment methods (8). Depending on the child's ability to communicate, pain is assessed by self-report, physiological parameters, or by observing the child's behavior.

Evaluation of postoperative pain in infants and young children

Self-rating scales cannot be used because infants and young children cannot communicate verbally. Symptoms of pain in this age group include body stiffness, excessive facial expression (frown and exaggerated eye closure), sleep disturbances, loud crying, and the child's attempt to get away when touching the painful area of the body (9). Toddlers show aggression, crying, or trying to protect the painful part of the body. The

most commonly used pain scales for infants and young children are: Children's Hospital of Eastern Ontario Pain Scale (CHEOPS), Children and Infants Postoperative Pain Scale (CHIPPS), Revized Face, Legs, Activity, Cry, Consolability scale (FLAAC)'dır. On the other hand, the COMFORTyd scale evaluates both behavioral parameters and physiological (blood pressure, heart rate and muscle tone) parameters (10).

Evaluation of postoperative pain in preschool children

Children aged 3-7 can describe the severity of their pain and indicate its location. They can understand pain as punishment, complain and show aggression. At this age, scales based on both the clinician's observation and the child's self-expression are used. The most commonly used scales: Wong–Baker Faces Pain Rating Scale, OUCHER pain scale and The Faces Pain Scale – Revised (FPS-R) (Figure 1) (8).

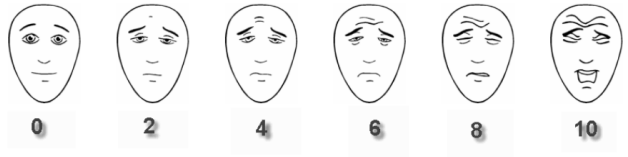

Figure 1. The Faces Pain Scale – Revised (FPS-R)

Evaluation of postoperative pain in school-age children

School-age children's reactions to pain and the words they use are influenced by the society they live in, and they often exhibit behaviors they learn from their families. School-age children can describe what they feel and show the location of pain in their body (11). The most commonly used scales are the Visual Analog Scale (VAS) (Figure 2), the Revised Facial Pain Scale (FPS-R), and the Numerical Rating Scale (NRS) (Figure 3).

Figure 2. Visual Analog Scale (VAS)

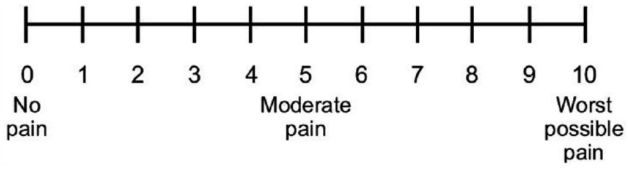

Figure 3. Numerical Rating Scale (NRS)

Evaluation of postoperative pain in unconscious or sedated children

Pain assessment is an important problem in unconscious or sedated patients. Behavioral Pain Scale (BPS), Intensive Care Pain Monitoring Tool (CPOT), Non-Verbal Pain Scale (NVPS) are recommended for pain measurement in unconscious or sedated patients. BPS is a scale based on the evaluation of body language, especially in intubated patients. A score of 6 or more indicates the need for analgesic therapy. NVPS evaluates facial expression, patient movements, vital parameters, and respiratory changes. If it is 3 points or higher, analgesia is required (5).

Postoperative Pain Management in Children

The severity of post-surgical pain and response to analgesic therapy are difficult to predict because there are many variables that differ depending on the child and surgical procedure. In order to provide optimal analgesic treatment and to evaluate the response to treatment, pain should be questioned frequently in the postoperative period. Analgesic therapy should be planned according to the expected intensity and duration of pain and titrated according to clinical response. Treatment should be flexible to accommodate patient differences and contingencies or events.

The severity and duration of postoperative pain is variable. Solitary lymph node excision, hydrocele surgery, skull-brain surgery are surgeries which relatively less severe postoperative pain is after expected, while incisional hernia repair, open cholecystectomy, tonsillectomy, spinal reconstruction, and kidney transplantation are surgeries which severe postoperative pain is expected (5). After pain is severe in almost every case in the early perioperative period and is expected to decrease in severity and resolve spontaneously in the days or weeks following the operation. In practical terms, this means that at the beginning, analgesic therapy should be given regularly (hourly-every 4 hours) until requirements begin to decrease. Later, when pain is detected or when pain is expected (for example, before mobilization), analgesic treatment can be planned "as needed" (8).

Pharmacological Approaches

Non-Opioid Analgesics

Paracetamol (acetaminophen), ibuprofen, and ketorolac are the most commonly used non-opioid analgesics in the treatment of postoperative pain in children (12).

The pharmacokinetic and pharmacodynamic effects of paracetamol in children are relatively well understood and can be administered safely provided dosage guidelines are followed. Existent for oral use in tablet, syrup and soluble forms, it can also be administered rectally, but the bioavailability

of rectal paracetamol is variable. Due to differences in the clearance, volume of distribution and half-life of the drug in newborns, the dose amount and dose frequency of paracetamol are different (8).

The recommended dose of oral paracetamol is 15-20 mg/kg every 4 hours. The maximum daily dose is 75 mg/kg in children, 60 mg/kg in term newborns and 45 mg/kg in premature babies (13). If the oral route is not preferred, a single rectal dose of 30-45 mg/kg can be given. Intravenous formulations are available and are useful in the postoperative period when oral medications are not preferred (14). The maximum daily dose of paracetamol is limited by the potential for hepatotoxicity after overdose (single or repeated doses exceeding 150 mg/kg in total). The toxicity is due to an oxidized metabolite of acetaminophen, which binds to glutathione and excess of which can lead to severe hepatotoxicity. Term neonates and children produce large amounts of glutathione and are thus relatively more resistant to toxicity (15-16).

Ibuprofen is the most commonly used non-steroidal anti-inflammatory (NSAID) drug in the form of syrup for the treatment of pain (17). Oral ibuprofen can be given as a single dose of 15m/kg or every 4-6 hours in children aged 3 months to 12 years. The maximum daily dose is 40mg/kg (12).

Ketorolac is another potent NSAID commonly used for postoperative pain and has been shown to reduce the need for opioid analgesic medication postoperatively. Ketorolac dose is 0.25- 0.5 mg/kg intravenously every 6 hours (7).

The mechanism of action of NSAIDs is through inhibition of cyclooxygenase activity, thereby blocking the synthesis of prostaglandins and thromboxane. Its side effects are gastritis, gastrointestinal bleeding, platelet and kidney dysfunction. Most of the toxicities associated with NSAIDs seen in adults are less common in infants (6 months and older) and children, owing to the absence of other comorbid diseases (18). Acetylsalicylic acid is not recommended in pediatric patients due to its association with Reye's syndrome.

Opioid Analgesics

Many physicians are reluctant to prescribe opioid analgesic drugs in adults and children because of fears about their side effects and potential for addiction. Studies have reported that respiratory depression due to opioid analgesics is not common (19). However, neonates have higher body water content, immature liver and kidneys, large volumes of extracellular fluid, slower gastric emptying, and less fat and muscle content as a percentage of body weight than older children and adults. In this way, the excretion of many drugs, including opioid analgesics, may be delayed (20).

Codeine is a weak-acting opioid analgesic that is usually administered in combination with paracetamol at a ratio of 20:1 (paracetamol 10-15mg/kg-0.5mg/kg codeine) for moderate pain in children older than 3 years of age (7). Codeine has become the most widely used agent among opioid analgesics in pediatric populations due to its good safety profile. However, codeine is a prodrug and the production of the active metabolite morphine is significantly affected by genetic polymorphism (8).

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Morphine is the prototype opioid; Diamorphine, hydromorphone, oxycodone and tramadol are frequently used alternatives to morphine in the postoperative period. The synthetic opioid family (fentanyl, sufentanil, alfentanil, and remifentanil) can be used after major surgery and perioperatively to reduce the stress response in intensive care or before surgery (8). Morphine has a slow onset of action and a long duration of action due to its low fat-soluble property (21,22). However, it may cause hypotension by causing histamine release, and its use in asthma patients is not recommended (21,23).

Fentanyl citrate is among the ideal opioid agents due to its lipophilic nature, rapid onset of action and short half-life. Its side effects on the cardiovascular and respiratory systems are limited. Fentanyl has an analgesic feature 100 times stronger than morphine and it is advantageous as it has alternative routes of use such as nasal, transmucosal and intravenous (22).

Opioids can cause a variety of side effects, but can be used safely for postoperative pain when dosage guidelines and simple management principles are followed. The synthetic opioid pethidine (meperidine) is not recommended for children because of the side effects of its main metabolite, norpetidine. Side effects of opioid analgesics such as nausea, vomiting, sedation, and respiratory depression are dose-related. However, different side effects can occur between different opioid drugs or between patients taking the

same drug.

Following appropriate training, patient-controlled analgesia (PCA) can be used in pediatric patients aged 6 years and older and nurse-controlled analgesia (NCA) in children over 6 years of age. Although intermittent bolus is mostly preferred, continuous infusion is recommended to keep the plasma concentration of the drug stable and to prevent fluctuations. However, there is a risk of sedation and respiratory depression during the administration of opioid analgesics with this method (22,24). Morphine in PCA; 0.01-0.003 mg/kg bolus dose (max. 0.15 mg/kg/hour), 0.01-0.03 mg/kg/hour continuous infusion, 5-10 min lock time, fentanyl; 0.5-1 µg/kg bolus dose (maximum 4 µg/kg/hour), 0.5-1 µg/kg/hour continuous infusion, 5-10 min lock time, hydromorphone 0.003-0.005 mg/kg bolus dose (maximum 0.02 mg/kg/hour), 0.003-0.005 mg/kg/hour continuous infusion, 5-10 min lock time is recommended (12).

The reported incidence of opioid-related respiratory depression and excessive sedation in hospitalized children ranged from 0.11 to 0.41%. Lung disease, liver disease and neurological comorbidities; being under one year old; premature birth; underweight or obese child; and concomitant use of other sedative or depressant drugs are risk factors for respiratory depression (25). Early recognition, respiratory support, and administration of naloxane significantly reduce the risk of permanent damage. Constipation, nausea, vomiting, itching and myoclonus are other side effects that may occur due to opioid drugs.

Regional Techniques

Regional anesthesia techniques have become popular in pediatric postoperative pain management because they provide good analgesia, reduce the need for intraoperative anesthetic drugs, provide painless recovery from anesthesia, and reduce surgical stress response. Regional techniques; includes topical anesthesia, infiltration, peripheral nerve blocks, and neuraxial analgesia (7).

Amide group local anesthetic agents (bupivacaine, levobupivacaine, and ropivacaine) are the most commonly preferred drugs by way of single dose (2-6 hours of action) or continuous infusion (8). Intraoperative single-dose blocks have a limited duration of action and carry the potential for serious side effects when recommended doses are exceeded. In terms of pharmacokinetics, the increased fraction not bound to free protein in children and the higher distribution volumes, although the excretion is low, reduces the risk of toxicity of local anesthetics (26). In pediatric patients, the maximum dose of bupivacaine and levobupivacaine is 2.5mg/kg for single injection and 0.25mg/kg for continuous infusion. Ropivacaine, on the other hand, should be limited to 3-4 mg/kg in a single injection, and 0.4 mg/kg/hour in continuous infusion (0,2 mg/kg/hour in infants aged 0-6 months). Lidocaine should not be given more than 7 mg/kg in a single injection, and no more than 7-10 mg/kg in prilocaine single injection applications (26).

Peripheral Nerve Blocks

Peripheral nerve blocks can provide analgesia in pediatric postoperative pain. It can be easily done in children using equipment similar to that used in adults, but small diameter needles are required.

Wound infiltration and simple nerve blocks (eg, ilioinguinal block and dorsal nerve block of the penis) are relatively easy, and the analgesic effect after a single dose injection reduces the need for analgesics in the postoperative period. If severe or prolonged pain is expected in the postoperative period, continuous or intermittent local anesthetic drug administration can be performed through catheters placed in an anatomically appropriate place.

Rectus sheath block can be performed for postoperative analgesia in umbilical hernia repair surgery, open pyloromyotomy, laparoscopic appendectomy and laparoscopic cholecystectomy. Ilio-inguinal nerve block provides analgesia for postoperative pain due to inguinal incision, such as herniotomy or orchidopexy. Penile block and dorsal nerve block of the penis can be applied in penile surgeries such as circumcision and hypospadias. Bupivacaine (0.1 ml/kg at 0.5% to 0.75% concentration) is frequently preferred (26,27).

Various peripheral nerve blocks can be applied and their use is dependent on the clinician's experience. After cleft lip repair, infra-orbital nerve block for analgesia and suprazigomatic maxillary nerve block for cleft lip repair can be performed. In upper extremity surgery, brachial plexus block or bier block with lidocoin can be performed. Femoral and sciatic blocks can be performed in lower extremity surgery.

Central Neuraxial Blocks

Neuraxial blocks include caudal, epidural, and spinal blocks. These are usually combined with general anesthesia for intraoperative and postoperative analgesia.

Local anesthetic injection into the caudal epidural space is a relatively simple and safe technique to provide analgesia in abdominal and perineal surgeries. The volume of local anesthetic to be injected can be calculated from the Armitage formula, and 0.5 ml/kg is recommended for sacrolumbar dermatomes, 1 ml/kg for lumbar and lower thoracic dermatomes, and 1.25 ml/kg for mid-thoracic dermatomes (7). The duration of analgesic effect can be prolonged by adding drugs such as clonidine, ketamine, dexmedetomidine and benzodiazepine to the local anesthetic drug (0.25% bupivacaine and 0.2% ropivacaine). However, concerns remain about their safety and potential for neurotoxicity. (8,28) Although complications related to caudal block are rare; systemic local anesthetic

toxicity, urinary retention, nerve damage, motor blockade and neurological deficit may develop.

Lumbar and thoracic epidural catheter applications are still controversial in pediatric patients due to serious complications. It has been reported that the incidence of permanent damage due to epidural catheters in children is 1:10 000, and the frequency of serious complications is 1:1000 (12).

Pre-emptive Analgesia

Preemptive analgesia is the administration of analgesic medication before surgical stimulation is given to prevent postoperative pain. It is based on preventing the formation of pain memory in the nervous system by preventing the formation of afferent input. Paracetamol or NSAID intravenous/rectal loading dose following anesthesia induction is recommended for preemptive analgesia in young children (29,30).

Postoperative Pain Unresponsive to Analgesic Treatment

Postoperative pain unresponsive to analgesic therapy may have several causes. First, it should be checked whether the prescribed analgesic drugs are actually given; Technical problems with infusion pumps should not be ignored. Complications such as infection, hematoma, anastomotic leakage, ileus, compression due to tight plaster should be questioned. It should be kept in mind that young children who cannot express themselves may be restless due to urinary retention, hunger, fear, or separation from their parents.

Conclusion

Control of postoperative pain is important for the child to have a more comfortable and trouble-free period after surgery. The management of pain following surgery in children should not be limited to only perioperative and postoperative approaches, but should also consider post-discharge pain and the risk of postoperative chronic pain. Guiding the treatment under the guidance of the relevant guidelines in pain treatment will help to provide a more effective pain treatment in the postoperative period.

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