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Chapter

Postoperative Pain in Pediatrics

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Abstract

Postoperative pain in pediatrics is a common concern for both parents and healthcare professionals. Children who experience pain after surgery can present with several complications, including nausea, vomiting, breathing difficulties, sleep disturbances, and decreased physical activity. In addition, untreated pain can have long-term effects on children's emotional and psychological well-being. It is important to recognize that children may experience pain differently than adults and, therefore, need a personalized treatment approach. Evaluation and management of postoperative pain in pediatrics should be based on the child's age, the type of surgery, and the severity of pain. Several treatment options are available, including oral, intravenous, and epidural analgesics, as well as non-pharmacological techniques such as relaxation and distraction. Prevention of postoperative pain is also important and can be achieved through the administration of analgesics prior to surgery and early postoperative care.

Keywords: postoperative pain, pediatrics, analgesia, pain management, pain treatment

1. Introduction

Surgery is a common medical procedure performed to treat various conditions. In pediatrics, surgery is often necessary to treat congenital diseases, developmental disorders, or traumatic injuries. Although surgery can be beneficial, postoperative pain is a common consequence that can negatively affect a patient's recovery. Treatment may include pain relievers, regional anesthesia, and nondrug therapies such as physical therapy and occupational therapy. Within the strategies to prevent postoperative pain, such as the use of less invasive surgical techniques and the administration of analgesics before surgery. A multidisciplinary approach to postoperative pain management in pediatric patients, involving physicians, nurses, physiotherapists, and occupational therapists helps improve the conditions of pediatric patients after surgery. The importance of education and preparation to the patients and their parents before surgery helps to reduce anxiety and stress. It is also useful to implement relaxation and distraction techniques to improve the patient experience as well as the importance of using multimodal analgesia in pain management. In summary, in this chapter, we will highlight the importance of proper postoperative pain management

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2. Causes of postoperative pain in pediatrics

The causes of postoperative pain in children are multiple and may vary depending on the type of surgery. Some common causes may include tissue inflammation, manipulation of organs during surgery, surgical incision, and muscle strain associated with the recovery process. In addition, postoperative pain can also be caused by psychological factors. Some of the common causes of postoperative pain in pediatrics include:

- Tissue damage: Surgery can cause tissue damage, which can trigger an inflammatory response in the body and lead to pain.
- Invasive procedures: Invasive procedures, such as the insertion of drainage tubes or the placement of intravenous lines, can cause pain.
- Surgical incision: The surgical incision can be painful and take time to heal.
- Anxiety: Anxiety and fear can increase the perception of pain in children.

3. Symptoms of postoperative pain in pediatrics

Postoperative pain in pediatrics can manifest itself in different ways, and the symptoms may vary depending on the age of the patient and the nature of the surgery. Some of the common symptoms of postoperative pain in pediatrics include:

- Inconsolable crying.
- Irritability or restlessness.
- Refusal to eat or drink.
- Difficulty to sleep.
- Changes in heart and respiratory rate.
- Excessive sweating.
- Changes in facial expressions such as frowning or closing your eyes.
- Fetal position or muscle tension.
- Changes in physical activity or movement patterns.
- Changes in urination and bowel movements.

Pain identification in pediatrics can be challenging, especially in young children or those who cannot communicate verbally. In older children, there may be verbal reports of pain, as well as facial and bodily responses to painful stimuli. It is important that healthcare professionals working with children are trained in pain assessment and use appropriate assessment tools based on the child's age and development to ensure accurate identification of pain [1].

4. Treatment of postoperative pain in pediatrics

It is important to treat postoperative pain in pediatrics effectively to minimize discomfort and promote faster recovery, so some of the challenges associated with managing postoperative pain in children, including the lack of objective measures to assess pain, the variability in individual response to pain, and the need to balance the efficacy of treatment with potential side effects. It is important to explore various strategies to overcome these challenges such as the use of validated pain scales, personalization of treatment, and continuing education of healthcare personnel [2]. Treatment of postoperative pain in pediatrics may include a combination of pharmacological and non-pharmacological techniques. Some common treatment options include:

- Validated pain scales: The use of validated pain scales is suggested to assess postoperative pain in children such as the face scale, the numerical scale, or the color scale. These tools can help assess pain level and guide appropriate intervention.
- Multimodal analgesia: The use of a combination of analgesics and techniques is recommended to address different aspects of postoperative pain in children. This may include the use of opioid and non-opioid analgesics, peripheral nerve blocks, local infiltration, or epidural infusions.
- Relaxation and distraction techniques: Relaxation and distraction techniques, such as music, games, and virtual reality therapy, are suggested to help patients manage pain and anxiety.
- Education and preoperative preparation: The importance of educating patients and their families on postoperative pain management and providing preoperative preparation to reduce anxiety and improve postoperative recovery is highlighted.
- Treatment personalization: It is recommended to personalize treatment for each patient based on their individual needs and response to pain.

In addition to these treatment options, it is important that parents and medical staff work together to create a calm and comfortable environment for the patient.

Multimodal analgesia may include a combination of different drug classes such as nonsteroidal anti-inflammatory drugs (NSAIDs), opioids, local anesthetics, and gabapentinoids [3]. Drug selection and dosage must be individualized according to the needs of the patient. Furthermore, the choice of regional anesthesia technique may also influence the selection of multimodal analgesia. Regional anesthesia, such

as epidural anesthesia or intravenous regional anesthesia, selectively blocks pain transmission from peripheral nerves to the spinal cord and brain, which may reduce the need for opioids and minimize opioid-associated side effects. In addition, regional anesthesia can reduce inflammation and the body's inflammatory response, which can help prevent chronic postoperative pain [4].

Some of the most commonly used NSAIDs in pediatrics include:

- **Ibuprofen:** It is one of the most commonly used NSAIDs in pediatrics due to its efficacy and safety. It is used to treat pain, inflammation, and fever. It is available in different formulations, including tablets, oral suspension, and rectal suppositories. The recommended dose is 5–10 mg/kg/dose, with an interval of 6–8 hours between each dose.
- **Diclofenac:** It is another NSAID that is used in pediatrics to treat pain and inflammation. It is available in different formulations, including tablets, rectal suppositories, and topical gel. In general, the recommended dose of diclofenac in children is 1–3 mg/kg/day, divided into 2–3 daily doses.
- **Naproxen:** It is an NSAID used to treat pain, inflammation, and fever in pediatrics. It is available in different formulations, including tablets and oral suspension. The recommended dose of naproxen in children is 5–10 mg/kg/dose every 12 hours, or 10–15 mg/kg/dose every 24 hours for the extended-release formulation.
- **Paracetamol:** This analgesic is not an NSAID. It is usually given as an oral suspension, and the recommended dose varies according to the age and weight of the child. In general, the recommended dose for children is 10–15 mg/kg/dose, with an interval of 4–6 hours between each dose. It is important not to exceed the maximum recommended dose.

It is important to note that NSAIDs can have side effects such as gastric irritation, gastric ulcers, and kidney problems, so they should be used with caution and under the supervision of a physician. Also, each patient may react differently to medications, so it is important to adjust the dose and treatment regimen individually for each child [5].

The use of opioids in pediatrics is used to control moderate to severe pain in children and adolescents. However, their use must be carefully supervised by a doctor as they can have serious and potentially dangerous side effects. Opioids are used in situations where non-opioid pain relievers are not enough to control pain. They can be used for the management of postoperative pain, cancer pain, and pain associated with chronic diseases [6]. It is important to note that prolonged use of opioids in children and adolescents may increase the risk of developing dependence and addiction. Therefore, steps should be taken to reduce the amount of opioids used and their duration, in order to minimize the risk of long-term health problems.

There are different opioids that can be used in pediatrics, some of them are:

- **Hydrocodone:** It is recommended to start with the lowest possible dose and adjust the dose as necessary to achieve effective pain control without causing

serious side effects. The recommended dose is 0.05–0.2 mg/kg every 4–6 hours as needed, with an upper limit of 5 mg per dose and 20 mg in 24 hours in children 6–12 years of age. In children over 12 years of age, the recommended dose is 2.5–10 mg every 4–6 hours as needed, with a maximum limit of 40 mg in 24 hours.

- **Fentanyl:** It can be administered by different routes, including intravenous, epidural, intrathecal, or transdermal, depending on the clinical situation of the patient. The recommended dose is 1–2 mcg/kg, administered intravenously, every 2–4 hours as needed.
- **Morphine:** It can be administered orally, intravenously, subcutaneously, epidurally, or intrathecally, depending on the clinical situation of the patient. The recommended starting dose is 0.1–0.2 mg/kg every 4 hours intravenously or every 6 hours orally. However, the dosage may vary depending on the condition of the patient and the severity of the pain.
- **Buprenorphine:** Unlike other opioids, buprenorphine has a ceiling effect, which means that its pain-relieving effect levels off at higher doses and does not increase beyond a certain point, reducing the risk of overdose. Additionally, buprenorphine has lower addiction potential and respiratory side effects compared to other opioids. The recommended dose in pediatrics ranges between 10 and 20 mcg/kg/dose every 6–8 hours. However, these doses may vary based on the weight and age of the child and may be adjusted as needed to achieve adequate pain control.
- **Tramadol:** It is important to note that the use of tramadol in pediatrics requires careful assessment of the benefit–risk balance, especially in children under 12 years of age and in those with risk factors for opioid-related adverse events. The recommended dose of tramadol is 1–2 mg/kg/dose, administered, orally every 4–6 hours as needed. The maximum daily dose should not exceed 8 mg/kg/day.

It is important to emphasize that the use of opioids in pediatrics must be carefully supervised by a physician since they can have serious and potentially dangerous side effects such as respiratory depression or excessive sedation. In addition, the dose and duration of treatment should be appropriate to the child's age and weight, and measures should be taken to reduce the amount of opioids used and their duration, in order to minimize the risk of dependence and long-term health problems.

Gabapentinoids, such as gabapentin and pregabalin, are also used in pediatrics for pain management. However, the evidence on its safety and efficacy in children is limited, and more studies are needed to determine its appropriate use in this population. Some studies have found that pregabalin may be effective for neuropathic pain in children and adolescents, but more research is needed in this field. Also, caution should be exercised when using gabapentinoids in children with kidney problems as these drugs are primarily eliminated by the kidneys [7].

The best option to decide pain management in pediatrics is the analgesic ladder. The pediatric analgesic ladder is based on the World Health Organization (WHO) initiative for pain management in adult cancer patients. In 1986, the WHO proposed

a guideline for pain management in adults with cancer, which became the WHO Analgesic Ladder in 1986. Later, in 1990, the WHO extended the analgesic ladder to include pain management in pediatric patients with cancer. Since then, the WHO analgesic ladder has become a standard guideline for pain management in pediatric and adult patients worldwide [8].

This staircase is divided into three levels:

- Level I: Non-opioid pain relievers (e.g., acetaminophen and ibuprofen).
- Level II: Mild to moderate opioid pain relievers (e.g., tramadol).
- Level III: Strong opioid pain relievers (e.g., morphine, fentanyl).

The idea is to start at the bottom of the ladder and work your way up as necessary to control the patient's pain. It is important to note that analgesic selection should be based on the etiology of the pain and the age and weight of the patient, and that the dose and frequency should be individually adjusted [9].

Within the non-pharmacological alternatives for pain management, we can find psychological intervention. For this type of treatment, the importance of accurate assessment and diagnosis of the cause of the pain is paramount since there are different psychological approaches such as cognitive behavioral therapy, acceptance and commitment therapy, interpersonal therapy, and family therapy. There is evidence that suggests that these therapies can be effective in the management of chronic and recurrent pain in children and adolescents, improving the quality of life, functionality, and psychological well-being of patients. However, there are also limitations of psychological therapies such as:

- Lack of high-quality studies: Although there are studies on psychological therapies in the management of chronic and recurrent pain in children and adolescents, many of them have methodological and design limitations, which limit the quality of the evidence.
- Heterogeneity in interventions: Psychological interventions include a variety of approaches and techniques, making it difficult to compare their effectiveness and determine, which is most appropriate for each patient.
- Lack of studies on specific populations: Most studies have been conducted in children and adolescents with chronic abdominal pain or headache, limiting the generalizability of the results to other populations.
- Difficulties in implementation: The implementation of psychological therapies can be expensive and require the training of specialized professionals, which limits their accessibility and availability in some health care settings.

However, more research is needed to determine the effectiveness of specific therapies for different types of pain: chronic and recurrent in specific populations of children and adolescents. To establish the best strategies for the implementation and integration of psychological treatments in pediatric medical care [10].

5. Prevention of postoperative pain in pediatrics

Although pediatric postoperative pain is often unavoidable, there are measures that can be taken to minimize its intensity and duration. Some strategies to prevent postoperative pain in pediatrics include:

- Use of less invasive surgical techniques.
- Use of regional anesthesia instead of general anesthesia.
- Administration of analgesics before surgery to prevent pain.
- Education and preparation of the patient and their parents before surgery to reduce anxiety and stress.

One of the methods most used by anesthesiologists is anesthetic adjuvants, which are drugs that are used in combination with local or general anesthetics to improve the efficacy of anesthesia and reduce postoperative pain [11]. In pediatrics, various anesthetic adjuvants are used to prevent postoperative pain, including:

- **Clonidine:** It is an alpha-2 adrenergic agonist that is used as an analgesic and sedative. Clonidine has been shown to reduce the need for opioid pain relievers after surgery in children. From 1 to 17 years, 2–5 micrograms/kg administered 30–60 minutes before the procedure, not to exceed the dose of 300 micrograms.
- **Ketamine:** It is a dissociative anesthetic that has analgesic and anesthetic properties. Ketamine has been shown to reduce postoperative pain and decrease the need for opioids in children. The dose for induction of anesthesia in healthy children is usually 1–2 mg/kg administered intravenously (IV), although it may vary according to the age and health status of the child, as well as the duration and type of procedure. For continuous infusion during surgery, the doses may be lower (0.25–0.5 mg/kg/hour).
- **Dexmedetomidine:** It is a clonidine-like alpha-2 adrenergic agonist used as an analgesic and sedative. Dexmedetomidine has been shown to be effective in reducing postoperative pain in children. In general, it is started with a low dose and gradually increased as needed. It is recommended that the dose of dexmedetomidine not exceed 1.5 mcg/kg/h in children. The following is a general formula for calculating the dose of pediatric dexmedetomidine:

Dexmedetomidine dose (mcg/kg/h) = body weight (kg) × starting dose (mcg/kg/h) × adjustment factor.

The adjustment factor varies according to the age of the child:

< 6 months: adjustment factor of 0.4.

6 months - 5 years: adjustment factor of 0.5.

- **Magnesium:** Magnesium has been shown to have pain-relieving properties and reduces the need for opioid pain relievers in children after surgery. In general, for the administration of IV magnesium in pediatrics, the recommended dose is

25 to 50 mg/kg, diluted in 5% saline or dextrose solution, at an infusion rate not greater than 150 mg/minute.

- Lidocaine: In addition to its use as a local anesthetic, lidocaine has been used as an anesthetic adjuvant to reduce postoperative pain in children. In regional epidural anesthesia, the dose of lidocaine is generally calculated based on the weight of the child, with a typical dose of 1–2 mg/kg. In local anesthesia, the maximum recommended dose is 4.5 mg/kg, and it can be reduced depending on the weight and age of the child.

Anesthetic adjuvants may offer several benefits in children, including:

1. Postoperative pain reduction: Anesthetic adjuvants, such as lidocaine or dexmedetomidine, may help reduce postoperative pain in children. This can improve children's quality of life after surgery and reduce the need for strong pain relievers.
2. Anxiety and stress reduction: Some anesthetic adjuvants, such as clonidine or midazolam, can help reduce anxiety and stress in children before surgery. This can make the process less scary and more manageable for the child.
3. Fewer side effects: Anesthetic adjuvants can help reduce the amount of general anesthetic needed for surgery, which can reduce side effects, such as nausea and vomiting.
4. Shorter recovery time: Some anesthetic adjuvants, such as dexmedetomidine, can help speed recovery time after surgery in children. This can reduce the need for a long hospital stay and help the child return to normal activities more quickly.

It is important to keep in mind that each child is different, and that the benefits of anesthetic adjuvants may vary depending on the case.

Another of the most widely used and recommended methods for postoperative pain management are non-pharmacological techniques, for example, stress and anxiety reduction. Strategies to reduce anxiety and stress in children before surgery can help prevent postoperative pain in several ways. First, by reducing anxiety and stress, the sensation of pain and the perception of its intensity can be reduced. Additionally, these techniques can help reduce the need for pain relievers and other postoperative pain medications, which can decrease the risk of side effects and complications. In addition, some techniques, such as muscle relaxation and meditation, can help improve sleep quality and reduce postoperative insomnia [12].

Some strategies that can help reduce anxiety and stress in these children include:

- Clear and precise information about the procedure: It is important that the child understands what will happen before, during, and after the surgical procedure. This can help to reduce anxiety and stress.
- Play therapy: Playful games and activities can be an effective way to reduce anxiety and stress in children facing a surgical procedure.

- Relaxation techniques: Relaxation techniques, such as deep breathing and visualization, can help reduce anxiety and stress in children.
- Use of antianxiety medications: Some antianxiety medications can help reduce anxiety and stress in children before the surgical procedure.

It is important that any strategy to reduce anxiety and stress in children who will undergo surgery is discussed with the medical team and that the most appropriate option is chosen for each child.

6. Scales to assess pain in children

Pain assessment in children can be challenging as children may have difficulty communicating their pain effectively. Therefore, it is important to use specific tools for pain assessment in children [13]. Some of these tools include:

- Numerical scales: These scales consist of the child assigning a number from 1 to 10 to indicate the intensity of his pain. Number scales are useful for older children who can count and understand number relationships.
- Face scales: These scales show a series of pictures that represent different levels of pain. The child chooses the drawing that best represents the intensity of her pain.
- Coloring scales: These scales consist of a drawing that the child must color according to the location and intensity of the pain.
- Behavioral rating scales: These scales assess the child's behavior rather than his verbal self-report. They are used for very young children who cannot yet communicate verbally.
- Structured clinical interviews: These interviews use specific questions to assess pain in children. They are used for children who have difficulty communicating their pain effectively.
- Among the most useful scales to assess pain in children who cannot communicate verbally such as infants or children with cognitive disabilities, as well as to standardize pain assessment in clinical and research situations, we can find the following:
 - Wong-Baker faces scale: uses drawings of faces for the child to choose the one that best represents their pain, from a smiling face without pain to a crying face in pain.
 - Numerical scale: The child is asked to assign a number from 0 to 10 to indicate the intensity of their pain, with zero being no pain and 10 being the most intense pain imaginable.

- Visual analog scale (VAS): A line is used that goes from one end indicating “no pain” to the other end indicating “unbearable pain,” and the child is asked to mark on the line the point that best represents their pain.
- McGill face scale: uses a series of pictures that represent different types of pain such as stabbing, cutting, burning, etc. The child selects the pictures that describe his/her pain.

It is important to note that no tool is perfect for all children and situations. Selecting the right tool for the child and his/her specific situation will help us to better identify the situation. In addition, it must be taken into account that the evaluation of pain in children must be continuous and adapted as the child grows and develops new communication skills.

In addition, the use of scales to assess pain in children allows health professionals to obtain information on the intensity, duration, and location of pain, which can be useful for adjusting treatment and for long-term follow-up. It also allows parents and caregivers to more accurately communicate the symptoms the child is experiencing, which can help improve the child’s care and quality of life.

It must be considered that the scales to assess pain should be selected based on the child’s age and level of development, and that they should be administered appropriately to obtain an accurate assessment of pain. Therefore, it is important that health-care professionals are trained in the use of these tools and ensure that they are used effectively to ensure the best possible pain management in children.

7. Conclusion

Pain is a subjective experience that can have a significant impact on the quality of life of children and adolescents. Therefore, it is critical to properly recognize, assess, and treat pain in this population. There are various treatment options available, including pharmacological pain relievers, psychological therapies, and less invasive surgical techniques. In addition, it is important to use pain assessment tools appropriate to the child’s age and developmental level such as validated pain scales. The implementation of multidisciplinary strategies that address pain comprehensively can significantly improve pain management in children and adolescents.

Postoperative pain is a common consequence of pediatric surgery, but it can be effectively treated. It is important that parents and medical personnel work together to identify and treat pediatric postoperative pain and take steps to prevent its occurrence whenever possible. By doing so, patient discomfort can be minimized and a faster and more complete recovery promoted.

Pediatric pain medicine is a constantly evolving field, with multiple strategies and tools available to address pain in children and adolescents. Research has shown that proper pain management in children not only improves a patient’s quality of life but can also reduce recovery time and length of hospital stay. In addition, a multidisciplinary approach and an individualized approach are essential to effectively treat pain in children. Less invasive anesthetic and surgical techniques, as well as anesthetic adjuvants, may be beneficial in managing postoperative pain in children. Relaxation methods, psychological therapies, and distraction strategies have also been shown to be effective in reducing preoperative anxiety and stress.

Finally, adequate assessment of pain in children is essential to achieve effective management. Pain measurement scales are an important tool and must be used regularly to identify pain and guide its treatment, so pain management in pediatrics is a crucial aspect of pediatric patient care and should continue to be investigated new strategies and tools to improve their treatment and relieve pain in children.

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