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Acute Pain and Analgesia in children

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Abstract

Acute pain is a complex process involving activation of nociceptors, chemical mediators and inflammation. All the major children's hospitals now have dedicated pain services to provide evaluation and immediate treatment of pain in any child. Children experience pain in a similar way to adults. Pain intensity in children depends on the surgical procedure itself but also on numerous other factors such as age, emotional state or the level of anxiety associated with the hospital stay. The perception and communication of the child's pain depends on his or her intellectual and social development. Expression of pain therefore relies on the child's ability to understand, quantitate and communicate it. Previous pain experiences or chronic diseases that required many medical procedures may significantly change the pain threshold in paediatric patients. Moreover, genetic predispositions and environmental effects are significant. The American Academy of Pediatrics and the American Pain Society have reiterated the importance of a multidisciplinary approach in order to eliminate pain in children. In all pediatric settings, an adequate assessment is the initial stage in a proper clinical approach to pain, especially in the emergency departments; therefore, an increasing number of age-related tools have been validated. Systemic opioids, nonsteroidal anti-inflammatory agents and regional analgesics alone or combined with additives are currently used to provide effective postoperative analgesia. These modalities are best utilized when combined as a multimodal approach to treat acute pain in the perioperative setting. The total number of behaviors that are present in the child are used to estimate his/her pain at the time of assessment. Pain assessment is important to facilitate effective postoperative pain management in these vulnerable children. The purpose of this study is to investigate acute pain as well as analgesia and availability of the used analgesic drugs in children. A multimodal approach to preventing and treating pain is usually used.

Keywords: Analgesia; Pain; Children; Drugs; Anesthesia; Surgery

1. Introduction

Pain is initiated when specialized nerves, called nociceptors, are activated in response to adverse chemical, thermal or mechanical stimulus. Activation can be direct due to trauma or indirect via biochemical mediators released from damaged tissues and circulation. These mediators can further augment the pain process by up-regulating pain receptors and recruiting additional surrounding nociceptors into activity. Mediators include, but are not limited to, prostaglandins, bradykinins, histamine, serotonin and arachidonic acid. The severity of the pain sensed is dependent on the number of receptors stimulated, the duration of the stimulus and the amount of mediators released locally. Once the nociceptor is depolarized, a signal is sent from the periphery into the dorsal horn of the spinal cord, where pain signals are integrated to elicit spinal reflexes such as withdrawal of the affected area, muscle spasms, and to release additional mediators within adjacent spinal segments and relay information to higher cortical areas. Nociceptors are divided into two major nerve groups based on presence or absence of myelination. Myelinated A-delta fibers transmit the signal rapidly and are responsible for the initial sharp pain changing later to burning or soreness. Unmyelinated C fibers are relatively slower in speed and are associated with deep aching or throbbing types of pain that follows the initial sharp pain. Both types of pain fibers then cross the midline and stimulate the ascending pain fibers in the spinothalamic tract.

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Substance P is one of the key neurotranmitters relaying the pain signal from the periphery and the spinothalamic tract. Fibers in the spinothalamic tract terminate in the thalamus, limbus and brain stem. Further information is transmitted to multiple cortical areas of the brain responsible for localization and pain perception. Descending pain fibers are in turn activated from the cerebral cortex via efferent pathway to the spinal cord and periphery and act to decrease the intensity of the pain signal via encephalin, serotonin and gamma aminobutyric acid (GABA) neurotransmitters. The autonomic nervous system can also be activated by pain. This occurs in large measure in the dorsal horn, and is responsible for the associated symptoms seen with pain such as nausea, sweating, alteration of heart rate and blood pressure. Nociception refers to the process in which specialized fibers in the peripheral nervous system transmit impulses from the periphery to the brain's higher centers through the spinothalamic tracts due to the connection of synapses within the spinal cord's dorsal. In the past, several studies have revealed the existence of distinct classes of nociceptors that, when activated by different stimuli, transmit signals through two basic types of afferent fibers: C fibers and A-delta fibers [1-3].

Pain is an unpleasant physical and emotional sensation that may be experienced in a unique manner by each child, due to differences in pain perception. Exposure to severe pain without adequate pain management has negative long-term consequences, including increased morbidity. Successful pain management in children involves identifying and assessing the pain, followed by prompt control of the pain through pharmacological management and resolution of the underlying cause. If unmanaged, pain can lead to anxiety and stress, and in the long-term this can impact on the psychosocial health and development of a child. Children are at increased risk for adverse drug effects from analgesic therapy if proper vigilance and monitoring are neglected. Analgesics and anesthetics are responsible for the majority of adverse drug effects in hospitalized children. application of the World Health Organization (WHO) pain ladder [4-9].

2. Clinical base of analgesia drugs

In children, acetaminophen is frequently the initial treatment for mild to moderate pain. A central effect of acetaminophen is the activation of descending serotonergic pathways. Its exact mode of action has not yet been determined. Ibuprofen is the preferred non-steroidal anti-inflammatory drug (NSAID) in children. The practice of combining paracetamol and ibuprofen or alternating doses has gained popularity. Although acceptable, this is not routinely recommended in children as there is currently a lack of evidence to support the safety or efficacy of this practice. Due to their mechanisms of action, using paracetamol and ibuprofen together theoretically increases the risk of renal and hepatic toxicity. Codeine and tramadol are not recommended in a general practice setting for use in children, as other analgesic options with better safety data are available. Codeine metabolism is even less predictable in children.Tramadol metabolism is also individually variable, resulting in different levels of the active component and uncertainty in dosage. Morphine is the prototype opioid that was first isolated from opium in 1804. Intravenous morphine is often the first drug used in most Emergency Departments to treat severe pain. Fentanyl is a purely synthetic, short-acting opioid, utilized for acute pain management and considered to be 50–100 times more potent than morphine.Intranasal fentanyl has a greater safety profile than intravenous morphine, without any difference in the effectiveness of pain control. It can be administered by intravenous or intranasal routes, and by transdermal patches. Transdermal fentanyl has been studied in children with chronic pain secondary to malignant and non-malignant diseases and was proved to be a valid alternative to more invasive administrations. Ketamine is an N-methyl-D-aspartate antagonist that prevents the central sensitization of nociceptors and inhibits peripheral nociception. It may be used to provide anaesthesia, sedation or analgesia. The effects of ketamine are dose-dependent, with analgesia without sedation occurring at around 10–30% of the dissociative dose. Nitrous oxide (N2O) is a useful agent for pediatric procedural sedation, because it provides a rapid onset and offset of sedation. A nasal or face mask or muzzle is used to self-administer N2O via a demand valve system or continuous flow. It can be administered as 50% or 70% with oxygen for both analgesia and sedation; the higher dose provides a similar sedation depth with no increase in adverse events. Despite its efficacy, some studies indicate that N2O alone provides limited pain relief during extremely excruciating procedures, such as fracture reduction. The most frequent adverse events reported are nausea, vomiting, agitation and dizziness. A non-pharmacological approach to pain includes psychological, behavioral and physical interventions used as adjuncts to pharmacological treatment and consist of physical comfort measures and distracting activities [10-15].

3. Management and Outcomes

There are still no universal tools for pain assessment that could be used in all children; therefore, the available tools should be adjusted to individual age groups. The scales most commonly used in young children rely on pain assessment conducted by the medical personnel and mainly involve the assessment of their behaviour, FlACC (Face, legs, Activity, Cry and Consolability) and/or physiological parameters, CRieS (Crying, Requirement for O2, increased heart rate,

expression, Sleeplessness). in older children, it is possible to use self-report scales, the VAS (Visual Analogue Scale), the NRS (Numeric Rating Scale), or the FACeS pain Rating Scale. Some of the scales enable not only recognition of pain but also determination of its intensity the simplest and most common classification of pain intensity divides it into three levels: mild – 1–3 VAS/NRS/ FlACC points; moderate – 4–6 VAS/NRS/FlACC points; and strong/severe – 7 or more VAS/NRS/FlACC points. It should be remembered that pain intensity has to be assessed both at rest and in dynamic conditions. Surgical procedures and painful diagnostic procedures are the main causes of this unpleasant and dangerous phenomenon for hospitalized children. It should be remembered that maintaining homeostasis in a child undergoing surgery is also affected by provision of an adequate level of analgesia and sedation as well as nerve conduction block within the surgical site. Inadequate treatment of acute pain may have both short- and long-term repercussions. Neuroimaging studies have discovered long-lasting modifications in brain structure and connectivity correlating with the amount of acute pain exposure during the perinatal period and with subsequent cognitive and behavioral effects in adult age. The American Academy of Pediatrics and the American Pain Society (2001) reiterated the need to eliminate pain in pediatric patients, using a multidisciplinary method. An ideal way to provide better postoperative analgesia in children is the use of multiple analgesics with additive or synergistic effects, yet with different side effect profiles so that adequate analgesia can be provided with the least amount of side effects.

4. Discussion

Children experience pain in much the same way as adults do, but may manifest or display that pain in a different way. Pain assessment tools can be considered, but these tools are subjective and may under or over estimate pain. Pain for children is often emotionally complex, and the involvement of parents and caregivers can add to the difficulty of management. These factors, along with a cautious approach to giving analgesia to children, can lead to pain being under-treated in some situations.

5. Conclusion

In order to facilitate the choice of the appropriate drug, a treatment algorithm based on a ladder approach can be used. Moreover, non-pharmacological techniques should be considered to alleviate anxiety and distress in pediatric age. Various considerations should be made to select the most appropriate analgesic medication. The initial assessment of pain represents the key stage in its management and relies on appropriate scales tailored to the patient's age and cognitive level. Multimodal analgesia may include pharmacology (basic analgesics, opioids, and adjuvant analgesia), regional anesthesia, rehabilitation, psychological approaches, spirituality, and integrative modalities, which act synergistically for more effective acute pediatric pain control with fewer side effects than any single analgesic or modality.

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