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Review Article

Effective pain management strategies for common pediatric conditions

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ABSTRACT

Pain management in neonates, infants, and children is a complex and challenging aspect of healthcare, with a high prevalence of undertreatment. Efforts have been made to improve pain assessment and implement effective interventions. Pharmacological approaches include non-opioid analgesics, opioids, and adjuvant analgesics, while non-pharmacological interventions involve physical techniques and cognitive behavioral strategies. Pediatric pain management requires considering developmental stages, individual variability, and emotional factors. Accurate pain assessment, weight-based dosing, and involving parents are crucial. Minimizing procedural pain and addressing psychosocial aspects contribute to better outcomes. Comprehensive pain management is necessary to prevent long-term consequences and enhance recovery. However, there is a persistent gap between evidence-based guidelines and clinical practice, indicating the need for further education and training. Implementation of pain management protocols and multidisciplinary approaches involving healthcare providers, psychologists, physical therapists, and educators are essential. By adopting these strategies, healthcare providers can improve the quality of life for pediatric patients, reduce the burden on the healthcare system, and mitigate the long-term impact of untreated pain.

Keywords: Analgesia, Sedation, Pain assessment, Pediatric acute pain

INTRODUCTION

Pain management in neonates, infants, and children is a complex and critical aspect of healthcare. Pain is a prevalent issue among pediatric patients, with estimates suggesting that 33-82% of hospitalized children experience moderate to severe pain, particularly following surgical procedures or painful interventions.[1] However, compared to adult patients, assessing and effectively managing pain in pediatric populations can be more challenging. Unfortunately, undertreatment or neglect of pain in children still persists in certain areas, partly due to persistent misconceptions surrounding infants' ability to perceive and remember pain.

Over the years, there has been a growing body of evidence highlighting the detrimental physiological effects of uncontrolled pain and the benefits of implementing effective analgesia in both adult and pediatric patients.[2,3] In response to this knowledge, efforts

have been made to develop new techniques and approaches to pediatric pain management. In 2001, the American academy of pediatrics and the American pain society released a joint statement advocating for comprehensive and interdisciplinary pain management in all children and adolescents.[4] This approach encompasses pharmacological interventions, cognitive-behavioral techniques, psychological support, and physical therapies.

Education plays a crucial role in improving pain management practices. Pain has been recognized as the "fifth vital sign," emphasizing the need to assess and address pain alongside other vital signs. The world health organization (WHO) pain ladder, initially designed to guide cancer pain management, has been expanded to encompass acute, procedural, and chronic pain in pediatric patients as well.[5]

Chronic pain is a significant problem among children and adolescents, with epidemiological studies reporting that approximately 30% of this population experiences pain lasting for three months or longer.[6,7] Common chronic pain complaints in pediatrics include migraines, recurrent abdominal pain, and musculoskeletal pain such as limb pain and back pain. Chronic pain often leads to functional disabilities, such as difficulties in school performance, maintaining social connections, reduced participation in recreational activities, impaired health-related quality of life, and increased healthcare utilization.[8] As a result, the burden on the healthcare system caused by these patients is substantial, and the impact on public health is significant.[9] Comprehensive approaches involving multidisciplinary teams, including healthcare providers, psychologists, physical therapists, and educators, are essential for the successful management of chronic pain in pediatric patients.[10] These approaches aim to alleviate pain symptoms, enhance physical and psychosocial functioning, improve overall well-being, and reduce the economic burden on healthcare systems.

LITERATURE SEARCH

Study based on comprehensive literature search conducted on June 20, 2023 in Medline and Cochrane databases, utilizing medical topic headings (MeSH) and combination of all available related terms, according to database, to prevent missing any possible research, manual search for publications conducted through Google Scholar, using reference lists of previously listed papers as starting point. We looked for valuable information in papers that discussed pain management strategies for common pediatric conditions. There were no restrictions on date, language, participant age/type of publication.

DISCUSSION

Pain assessment

Pain management in the pediatric population remains inadequate, and pain assessment is often lacking in hospitalized children. Frequent and well-documented pain assessment is crucial for effective pain management, with self-report being the preferred method whenever possible. However, in young or non-communicative children, behavior-based measures can serve as alternatives to self-reporting.[11,12] Physiological parameters and reports from caregivers can also contribute to the overall pain assessment.[13] Various reliable methods for pain measurement exist, including biological measures, observational and behavioral measures, and self-report measures.[14] Infants and non-verbal children can be assessed using behavioral indices such as motor responses, vocalization, facial expressions, and crying. The children's hospital of Eastern Ontario pain scale (CHEOPS) is commonly used for pain management.[15] As children age, observational and self-report scales become increasingly useful. Composite measures, such as the objective pain scale and the comfort Scale, combine behavioral and physiological items for pain assessment.[16] Self-report measures, relying on cognitive and linguistic development, are considered the gold standard in older children.[15] Visual analogue scale (VAS) and facial pain scale are commonly used self-rating scales for pain intensity assessment.[17] While pain assessment tools are valuable, they should be complemented by patient satisfaction, family feedback, nurse assessments, and physiological parameters to provide a comprehensive understanding of pain. Regular pain assessments tailored to individual patients are essential, and high-risk patients should be assessed every 2-4 hours.[18] Adequate pain assessment improves comfort, reduces pain undertreatment, and enhances communication among healthcare professionals. Implementing simple pain measurement methods not only improves pain relief but also decreases the workload for nurses and creates a common language for effective communication within the medical team.

Pharmacological interventions

Analgesic pharmacotherapy is essential for effective pain management, although complementary interventions may also be necessary in certain cases. Individualizing treatment is paramount, aiming to achieve and maintain a balance between pain relief and potential adverse effects of medication. The WHO has introduced the "analgesic ladder," a valuable approach for selecting drugs in acute and chronic pain states.[19] This three-step approach emphasizes pain intensity as the primary consideration in drug selection. According to step 1, mild to moderate pain should be managed with non-opioid analgesics, potentially combined with adjuvant drugs for specific indications. step 2 proposes that patients with moderate to severe pain, or those who do not achieve adequate relief with non-opioid analgesics, should be treated with opioids traditionally prescribed for this intensity of pain. Combination products containing both non-opioids (such as aspirin or acetaminophen) and opioids (e.g., codeine, oxycodone, or propoxyphene) are commonly used and can be supplemented with adjuvant analgesics. When step

3 is undertaken, patients with severe pain or insufficient relief from the second step should receive opioid agonists typically used for this intensity of pain. These opioids may be combined with non-opioid analgesics or adjuvant drugs. Analgesic drugs are generally categorized into three groups: non-opioid analgesics, opioid analgesics, and adjuvant analgesics.

Conventional non-opioid analgesics

Non-opioid analgesics, such as acetylsalicylic acid, acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAIDs), are a diverse group of compounds with shared pharmacological actions. These medications are effective for mild to moderate pain (step 1 of the analgesic ladder) and can enhance pain relief when used in combination with opioids for more severe pain.[20] Acetylsalicylic acid, a potent cyclo-oxygenase (COX) inhibitor, is widely used but not recommended for pregnant women or pre-pubertal children due to potential risks.[21] Acetaminophen, similar to NSAIDs, has analgesic and antipyretic properties with fewer side effects. Proper administration of acetaminophen in children is well-established and safe, but higher initial doses may be required for effective postoperative pain control. Adverse effects of non-opioid analgesics should be considered, such as bleeding, gastrointestinal complications, and renal impairment associated with NSAIDs.[22] NSAIDs that are selective COX-2 inhibitors or non-acetylated salicylates are preferred in patients prone to peptic ulceration or bleeding. However, COX-2 inhibitors are not approved for pediatric use.[23] Individualizing non-opioid analgesic administration requires understanding their clinical pharmacology and the need for dose titration to identify the most effective and safe dosage. NSAIDs, including acetaminophen, are commonly prescribed in pediatric hospitalizations for mild to moderate pain and have been shown to spare opioids effectively.[24] Care should be taken to avoid accidental overdose of acetaminophen, as intentional ingestion accounts for a significant proportion of pediatric cases requiring hospitalization.[25] Intravenous acetaminophen has been approved for the treatment of fever and mild to moderate pain in children above two years old, but careful dosing calculations are crucial to prevent overdoses. Various types of NSAIDs are available, with aspirin used less frequently due to the risk of Reye Syndrome.[26] Ketorolac, a non-selective COX inhibitor, is particularly useful in hospitalized patients but should be used cautiously in those at risk of bleeding.[27]

Opioids

Moderate to severe pain is commonly treated with systemic opioid analgesics.[28] To minimize side effects and reduce opioid requirement, a balanced analgesia approach is recommended.[29] Understanding opioid pharmacology, drug characteristics, and administration principles is crucial for optimal opioid use. The fear of side effects has limited opioid usage, but effective titration and careful monitoring have increased their use in both adult and pediatric patients. Opioid analgesics exert their effects by interacting with specific receptors in the brain and spinal cord. The activation of mu1 receptors in the brain and kappa receptors in the spinal cord leads to analgesia.[30] Tolerance to one receptor type does not necessarily confer tolerance to others. Opioid compounds are categorized as agonists, partial agonists, or mixed agonist-antagonists based on their interactions with receptor subtypes.[31] Pure agonist drugs, such as morphine and oxycodone, are commonly used for pain management in both adults and children. They have no ceiling effect for analgesia, meaning analgesic effects increase as the dose is raised until analgesia is achieved, or the patient loses consciousness. Adverse effects limit the useful dose and finding the balance between analgesia and side effects is crucial. Respiratory depression, nausea, vomiting, urinary retention, and physical dependence are common side effects of opioid drugs.[32] Respiratory depression can be treated with naloxone, an opioid antagonist. Nausea and vomiting may occur through central and peripheral mechanisms but can be managed with antiemetics if needed. Urinary retention is rare and mainly observed in elderly male patients. Physical dependence can be minimized by avoiding abrupt discontinuation and using tapering schedules. Opioid agonists are traditionally categorized as weak or strong opioids based on their use in pain management. However, this distinction is based on customary practices rather than fundamental pharmacological differences. Controlled-release formulations of opioids provide convenience and can be used for severe or moderate pain based on individual patient needs.[29] The selection of opioids depends on pain intensity and co-existing diseases. Combination products containing opioids and non-opioids are commonly used for moderate pain, with dose escalation as needed.[33] Sequential trials of different opioids may be required to identify the most effective and well-tolerated drug. Liver and renal impairment can affect opioid clearance and require caution and monitoring. Opioids should be administered through the least invasive and safest route that provides adequate analgesia. Oral administration is preferred, but alternative routes like rectal, transdermal, and sublingual can be used when necessary. Patient-controlled analgesia (PCA) is a widely used method for opioid delivery, allowing patients to self-administer small doses through an infusion pump.[34] PCA can be safely used in pediatric patients, typically aged six years and older. The dosing of opioids in PCA should be individualized based on pain intensity and monitoring parameters. PCA with a background infusion may be used in specific cases, but its benefits over PCA without a background infusion are not well-established. Monitoring for opioid withdrawal is important, and weaning protocols should be implemented to avoid withdrawal symptoms.

Other analgesics

Adjuvant analgesics are drugs primarily used for conditions other than pain but can also provide pain

relief.[29] They are frequently combined with primary analgesics to improve outcomes and minimize side effects. The choice of adjuvant analgesic is guided by pain characteristics and other related symptoms. Dose titration is commonly employed since the analgesic effects of most of these drugs are not well understood.[35] Starting with low initial doses helps avoid early side effects, although it may delay the onset of pain relief. Patient education is essential to ensure compliance with therapy. Corticosteroids are widely used adjuvant analgesics that offer pain relief in various conditions.[36] Local anesthetics, such as lidocaine and bupivacaine, administered topically or locally, are effective in managing post-operative pain.[37] Neuroleptics like methotrimeprazine can alleviate pain associated with anxiety, restlessness, or nausea.[38] Benzodiazepines are primarily used to manage anxiety and muscle spasms but have limited analgesic properties.[39] Multimodal analgesia approaches are recommended, including non-opioid medications like acetaminophen, NSAIDs, antispasmodics, gabapentinoids, and intravenous ketamine.[40] For specific situations like scoliosis repair or lower limb orthopedic procedures, drugs such as methocarbamol, diazepam, or ketamine may be beneficial in managing muscle spasms or neuropathic pain. Gabapentin or pregabalin, anticonvulsants, can be helpful for neuropathic pain but require careful dose adjustment and monitoring.

Non-pharmacological interventions

Non-pharmacologic approaches are an essential part of the multimodal pain management strategy. Physical interventions like massage, heat, cold therapy, repositioning, and light physical activity can be beneficial.[41] Cognitive behavioral techniques, such as relaxation and imagery, may also provide relief. Hypnosis has shown effectiveness in reducing pain in pediatric patients. Psychosocial factors like anxiety, catastrophizing, and depression should be considered as they can influence pain perception and exacerbate acute pain.[42] During assessments, observing the patient's behavior and interactions or asking specific questions can help identify these factors. Tailored management strategies involve addressing patient concerns, validating their fears, and reviewing the pain plan. In cases of severe anxiety or depression, consulting a psychiatrist for pharmacologic or non-pharmacologic interventions may be necessary.

Special considerations for pediatric pain management

Pain management in children requires healthcare providers to consider their unique characteristics and developmental stages. Accurate assessment of pain is crucial, utilizing age-appropriate tools and techniques that consider a child's cognitive and linguistic abilities.[43] Pediatric patients exhibit individual variability in their response to pain and analgesics. Factors such as genetics, previous pain experiences, and psychosocial factors influence a child's pain perception and their response to pain management interventions.[44]

Medication dosing in children should be based on weight rather than age.[29] Variations in body water composition, metabolic rate, and plasma protein binding often balance each other out, resulting in minimal changes in dosage requirements.[45] However, due to the immaturity of metabolic pathways and clearance mechanisms, it is often necessary to extend the time intervals between recommended doses. Weight-based dosing guidelines specific to the pediatric population should be followed to ensure the safe and effective use of analgesics.

Children's neurobiological and cognitive development also plays a significant role in their pain experience. The ability to understand and communicate pain varies across different developmental stages.[46] Healthcare providers must consider these developmental factors when assessing and managing pain in children, adapting their approaches accordingly. Non-verbal cues such as facial expressions, body language, and physiological signs of distress provide valuable insight into a child's pain experience when they are unable to express pain verbally.[43]

Emotional factors such as fear, anxiety, and distress commonly accompany pain in children, intensifying their perception of pain and contributing to a negative overall experience.[42] Addressing these emotions through psychological support, distraction techniques, and creating a comforting environment can significantly enhance pain management outcomes. Parents and caregivers play a crucial role in advocating for their child's pain management needs. Collaboration with parents ensures that pain management plans align with the child's unique needs and cultural preferences, leading to more effective pain relief.[47]

Efforts should be made to minimize pain associated with medical procedures. Utilizing appropriate local anesthesia, distraction techniques, and comforting measures can significantly reduce procedural pain.[48] Pre-emptive analgesia, providing pain relief before the procedure, can contribute to a more positive experience for the child. Uncontrolled or undertreated pain in children can have long-term physical, psychological, and emotional consequences.[49] Adequate pain management is crucial in preventing these adverse effects and promoting better recovery and overall well-being. By prioritizing comprehensive pain management strategies that address the unique needs of each child, healthcare providers can ensure optimal outcomes and improve the quality of life for pediatric patients.

CONCLUSION

Pain management in children requires tailored approaches considering their unique characteristics and developmental stages. Accurate pain assessment using

age-appropriate tools is crucial, along with recognizing individual variability in pain response and medication dosing based on weight. Understanding children's neurobiological and cognitive development helps adapt pain management strategies, particularly when they cannot express pain verbally. Addressing emotional factors, involving parents, minimizing procedural pain, and ensuring adequate pain relief are essential. Uncontrolled pain in children can have long-term consequences, emphasizing the importance of comprehensive pain management. By prioritizing these considerations, healthcare providers can improve outcomes and enhance the well-being of pediatric patients.

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