

## Review

# Efficacy, Safety and Complication of Epidural Analgesia in Pediatrics

Ahmed Bogari<sup>1\*</sup>, Abdulkhalek Abduljaleel<sup>1</sup>, Faryda Al shbib<sup>2</sup>, Zahra AlGhirash<sup>3</sup>, Alaa Haider<sup>4</sup>, Nouran Almeahmadi<sup>5</sup>, Raghad Mahyuddin<sup>6</sup>, Rakan Alotaibi<sup>7</sup>, Shuaa Aljaber<sup>8</sup>, Mohammad Alghamdi<sup>9</sup>, Banan Julaidan<sup>10</sup>, Faisal Alshehri<sup>11</sup>

<sup>1</sup> Department of Anesthesiology and Intensive Care, King Fahad General Hospital, Directorate of Health Affairs in Jeddah, Ministry of Health, Jeddah, Saudi Arabia

<sup>2</sup> Pharmacy Department, Al-Ahsa Health Cluster, Hofuf, Saudi Arabia

<sup>3</sup> Abu Shajrah Primary Healthcare Center, 32 Dental Clinic, Hofuf, Saudi Arabia

<sup>4</sup> Department of Pediatrics, Salmaniya Medical Complex, Manama, Bahrain

<sup>5</sup> College of Medicine, Arabian Gulf University, Manama, Bahrain

<sup>6</sup> College of Medicine, Batterjee Medical College, Jeddah, Saudi Arabia

<sup>7</sup> College of Medicine, Taif University, Taif, Saudi Arabia

<sup>8</sup> Hofuf Primary Healthcare Center, Hofuf, Saudi Arabia

<sup>9</sup> Pharmacy Department, Dhurma General Hospital, Riyadh, Saudi Arabia

<sup>10</sup> College of Medicine, Ibn Sina National College, Jeddah, Saudi Arabia

<sup>11</sup> Department of Emergency Medicine, King Abdullah Hospital, Bisha, Saudi Arabia

**Correspondence** should be addressed to **Ahmed Bogari**, Department of Anesthesiology and Intensive Care, King Fahad General Hospital, Directorate of Health Affairs in Jeddah, Ministry of Health, Jeddah, Saudi Arabia. Director of the Anesthesiology Program Sector Two-Western Region at SCFHS. Email: [abogari@moh.gov.sa](mailto:abogari@moh.gov.sa)

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### Abstract

For managing different types of pain, epidural analgesia is widely used in adults. Its application in children is less common and subject to discussion. This article seeks to investigate the evidence concerning the efficacy, safety, and potential complications of analgesia in patients. We analyzed randomized controlled trials, observational studies, and systematic reviews that compared analgesia to pain management methods or placebo for children undergoing surgery or experiencing acute or chronic pain. The findings indicated that epidural analgesia effectively reduced pain intensity and opioid consumption in children undergoing types of surgeries—especially thoracic, abdominal, and orthopedic procedures. Epidural analgesia has also been proven to create satisfaction and improve the quality of life for children experiencing cancer pain or sickle cell crisis. The use of analgesia may result in some side effects, like itchiness, feelings of nausea, vomiting, difficulty urinating, and low blood pressure. Serious complications such as hematoma, infection, nerve damage, or respiratory depression were occurrences. Affected less than 1% of patients. In summary, we conclude that epidural analgesia is an option for pain management as it offers relief with minimal risk of significant complications. Nonetheless, further high-quality studies are required to compare techniques, medications, and dosages of analgesia, specifically in children, while also evaluating its long-term outcomes.

**Keyword:** Epidural analgesia, Pediatrics, Pain Management, Efficacy, Safety complication

**Introduction**

Ensuring pain management in healthcare is crucial particularly when considering the wide-ranging impacts of untreated pain. Children who undergo surgeries or deal with chronic illnesses are especially vulnerable to the physical, psychological, and social effects caused by pain (1, 2). When pain control is insufficient, it does not only affect the children's well-being. It also puts significant stress on their families and caregivers (3). As a result, pediatric pain management plays a role in healthcare by aiming to alleviate suffering and enhance the child's recovery and quality of life. Within this field, there are strategies that encompass both pharmaceutical and non-pharmacological interventions. However, the use of analgesia, in some cases, shows great potential but is not commonly utilized (4). This technique involves administering anesthetics or opioids directly to space, which is located between the dura mater and the vertebral periosteum. What makes epidural analgesia unique is its ability to continuously or intermittently block the nerves for transmitting pain signals from the surgical or affected area to the brain (5). Additionally, it allows for lower doses of opioids to be used, thereby reducing absorption and potential side effects. While epidural analgesia is widely practiced in adults after surgeries or for managing cancer-related pain, its implementation in patients has a lower prevalence and remains a subject of ongoing discussion (6, 7). There are reasons why healthcare providers may hesitate to use analgesia in children. One factor is the lack of protocols specifically designed for patients. Additionally, It is important to know that there is a very few of healthcare providers with training and the necessary equipment, which creates barriers (8, 9). The challenges of assessing pain in children and monitoring their sedation levels further contribute to reservations about using this technique. Healthcare providers also have concerns about complications and how they may affect patients. This review study aims to evaluate the existing evidence on analgesia in pediatric patients. It explores the complexities of managing pain in children focusing on its effectiveness, safety, and potential complications. One thing that needs to be noticed is that children's

anatomical characteristics are different compared to adults. Therefore, it's crucial to consider whether the benefits observed in adults can be directly applied to patients undergoing analgesia. By examining the nuances, advantages, and potential risks associated with this technique in this demographic, we can optimize pain management strategies for patients. Ultimately, this effort contributes to improving care for children by prioritizing pain relief and their holistic well-being. The aim of this study is to find efficacy, safety, and complication of epidural analgesia in pediatrics.

**Review**

Regional anesthesia is an established method of pain relief for children, with caudal anesthesia being the most commonly used due to its simplicity and safety (10, 11). However, one drawback of caudal and single-shot epidurals is that they provide pain relief after surgery. This is where continuous infusion techniques using catheters come into play and become more important. Providing analgesia for children can be challenging due to factors such as difficulty in assessing pain accurately across different age groups, concerns about drug dosing safety, patient acceptance, lack of expertise, and the need for supervision.

***Clinical manifestation***

Although there are several techniques available for relieving pain, epidural analgesics may contain the most used case and are widely used (12). The process involves the administration of medications, like anesthetics, opioids or other drugs through injections, into the region surrounding the cord and nerves commonly referred to as the space. It is commonly used to provide pain relief during surgeries and for pain in children. However, it is crucial to take into account and effectively handle the risks and challenges connected with employing this method. It's worth noting that major complications following lumbar epidural analgesia in children are generally less frequent compared to adults due to these procedures usually being performed by anesthetists (13, 14). While administering these drugs, there are numerous complications can arise. In that case, a study found

that around 5% of cases experienced failure or incomplete pain relief due to a block. Technical issues may also occur in around 11-17% of cases leading to discontinuation of the procedure due to problems like leakage, occlusion, or disconnection within the system (15). Although this effectiveness varies upon an individual, children's effectiveness differs from adults. This may have other factors such as the specific drugs used (type, dose, concentration), the level and duration of the block achieved, the nature and extent of the surgery or pain being addressed, and each child's individual response. Several research studies have found that epidural analgesia can potentially alleviate pain, reduce the need for opioids and minimize side effects in children undergoing procedures such as thoracotomy, laparotomy, spinal fusion or limb surgery. Moreover, epidural analgesia can also impact functionality mitigate the stress response and aid in mobilization and recovery. Although, there is nothing worth on that, this method can be employed to manage pain conditions like sickle cell crisis, pancreatitis or burns in children. The safe administration of analgesia in patients relies on the expertise and experience of anesthesiologists along with the availability of monitoring equipment. It also depends on following techniques and infection control measures during the procedure as well as providing appropriate postoperative care and follow-up for the child (16). Children who are given pain relief may encounter effects such, as itchiness sensations of queasiness throwing up challenges, in urination (urinary retention) temporary loss of movement (motor block) low blood pressure (hypotension) and decreased respiratory rate (respiratory depression) (17). However, these side effects can be. Managed by administering drugs at doses and concentrations based on the children's weight and age. Regular monitoring of signs and urine output is important. If necessary, antiemetic or antipruritic medications can be given. Encouraging fluid intake or using a catheter to empty the bladder may also be helpful. In case it is needed, oxygen therapy or ventilator support can be provided. While rare occurrences happen but serious complications associated with analgesia in children include puncture of the protective covering around the

spinal cord (Dural puncture), formation of blood clots within epidural space (epidural hematoma), infection in the epidural space (epidural abscess), nerve damage from needle insertion (nerve injury) toxicity caused by local anesthetics reaching high levels, in bloodstream(local anesthetic toxicity) and extensive anesthesia affecting multiple body functions(total spinal anesthesia) (13, 18). If any of these issues occur, it is important to recognize and resolve them as they could potentially jeopardize someone's life. The factors that increase the likelihood of experiencing these complications involve disorders related to blood clotting, infections, physical injuries, repeated attempts, excessive drug doses or amounts, and insufficient supervision or monitoring. There are different types of indication techniques available that could be used for the identification of any complication, or any form of leakage consists or not during the process. Some complications may include leakage of fluid headaches following a puncture in the mater (the outermost layer surrounding the spinal cord), discomfort in the back area, neurological impairments, fever, inflammation, and reddening of affected areas, seizures, cardiac arrest episodes, and loss of consciousness. It may involve procedures, like a blood patch or surgical decompression as the use of antibiotics, anticonvulsants, lipid emulsion, and resuscitation measures.

### ***Treatment***

Epidural anesthesia is a used product that can effectively alleviate pain. It is also utilized to provide relief for children undergoing procedures or dealing with conditions such as thoracic orthopedic surgeries, urologic surgeries, oncologic surgeries, sickle cell crises and post neuralgia. However, it is crucial to consider and address the risks and complications associated with analgesia. This essay will explore the efficacy, safety measures and potential complications of utilizing analgesia in cases based on evidence and guidelines. Studies have indicated that compared to opioids epidural analgesia proves effective in reducing pain intensity limiting consumption and minimizing related side effects, among children undergoing diverse surgical procedures. For instance, a comprehensive analysis

of 18 randomized controlled trials involving 1059 children discovered that epidural analgesia resulted in a reduction of 1.3 points in pain scores on a scale of 10 when compared to the use of opioids. Furthermore, epidural analgesia significantly decreased nausea. Vomiting by 60%, pruritus by 74%, and respiratory depression by 82%. Another analysis encompassing 12 RCTs and including 742 children demonstrated that epidural analgesia led to a decrease of 1.6 points on a scale of 10 for pain scores when compared to opioids. The use of analgesia also resulted in a decrease in postoperative morphine usage by 70%. Furthermore, it demonstrated a decrease of 67%, in the occurrence of nausea and vomiting, a 76% reduction in pruritus (the sensation of itching) and an impressive 86% decline, in depression (19). Epidural analgesia also offers pain relief for children experiencing sickle cell crisis, a condition characterized by pain caused by the blockage of blood vessels by sickle-shaped red blood cells (20). A study involving 11 children with sickle cell crisis who received analgesia found that all patients experienced pain reduction within 24 hours of starting the treatment, and none required additional systemic opioids or blood transfusions. In addition to pain relief, epidural analgesia improved oxygen saturation levels, hemoglobin levels, and hydration status in these patients. It is generally considered safe to perform analgesia in cases when experienced clinicians follow strict protocols for patient selection monitoring, dosing, and complication management. Some common side effects of pain-relieving medication are often linked to the usage of anesthetics or opioids. These may include blood pressure, slow heart rate, difficulty urinating, motor impairment, nausea, vomiting, itchiness, sedation, respiratory depression, and urinary retention. However, it can be minimized by using doses of anesthetics and opioids based on patient response and regularly monitoring vital signs and consciousness levels. If needed additional actions, like giving fluids using medications such as vasopressors, antiemetics, antipruritics, naloxone or oxygen can also be taken to provide support (21, 22). Inserting or manipulating the needle or catheter during analgesia can result in complications. These complications may include infections, hematomas,

abscesses, nerve injuries or damage to the cord. These complications are very uncommon. It can have consequences for the patient. Complications in the field of pediatrics are estimated to occur in 1 out of every 10,000 to 1 out of every 1,000 cases. Several factors contribute to the likelihood of these complications, including being than one-year-old having clotting disorders a weakened system, infection at the site of insertion or elsewhere in the body experiencing trauma during needle or catheter placement or removal for an epidural prolonged use of epidural catheters (more than 72 hours) multiple unsuccessful attempts, at placing an epidural and using indwelling catheters. To minimize these risk factors, it is crucial to maintain a technique during needle or catheter insertion and removal procedures to avoid excessive puncturing or manipulation of the needle or catheter by utilizing ultrasound guidance or nerve stimulation for accurate placement. Remove the catheter promptly after surgery or when the pain subsides significantly while closely monitoring for several signs of infection which including fever, chills and neurological issues (like back pain, redness/swelling at insertion site), including numbness/weakness in lower limbs and bowel/bladder dysfunction. The management approach for analgesia complications in patients depends on the specific type and severity of the complication as well as resource availability and expertise. The key principles for managing complications involve recognizing and diagnosing the issue, stopping the infusion, taking out the epidural catheter providing suitable treatment and supportive measures, and seeking advice from specialists when necessary. For instance, if a child experiences blood pressure or slow heart rate as a result of analgesia, it is important to halt epidural infusion. It's essential to keep an eye on blood pressure and heart rate while also providing fluids and vasopressors to help the body recover its functioning. If the use of analgesia leads to depression, it is important to stop the infusion. It is advised to monitor the heart rate and oxygen saturation and provide oxygen as needed. If any patients get affected by opioids, this can be countered by drugs like Naloxone. It would be beneficial to conduct blood tests to examine the



fluid and administer antibiotics and steroids if needed. Moreover, it is crucial for the child to undergo examination and treatment, under the supervision of a neurologist.

### Conclusion

For relieving pain, it is necessary to use epidural analgesia, but for children, the technique of administration is different since their anatomical characteristics are not the same as adults. However, it is crucial to understand the risks and complications that come with it and handle them carefully. Experienced and trained healthcare professionals should perform epidural analgesia following strict protocols for patient selection monitoring, dosage administration, and complication management. It's also crucial to incorporate a pain management strategy that includes pharmacological techniques like distraction, relaxation, massage, music therapy, or play therapy. Furthermore, there are several forms of drugs that also help in pain relief. These drugs may vary since several drug types like painkillers, anti-inflammatories, or some other drug, e.g. ketamine, lidocaine, etc. used. This is part of the pain management strategy. By adopting a comprehensive approach to pain management, policy makers can enhance the quality of care provided to children and achieve better outcomes.

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#### *Data availability*

Data that support the findings of this study are embedded within the manuscript.

### *Author contribution*

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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