

## STUDY OF THE CONSEQUENCES OF INHALATION ANESTHESIA IN CHILDREN UNDERGOING INGUINAL HERNIA REPAIR SURGERY UNDER GENERAL ANESTHESIA, LITERATURE REVIEW

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### Abstract

**Background:** Anesthesia in pediatric patients, particularly neonates and infants undergoing inguinal hernia repair (IHR), has been a subject of extensive research due to concerns about potential neurodevelopmental and cognitive effects. Studies on the impact of anesthesia on early childhood development, especially those involving general anesthesia (GA), have raised important questions about both short-term and long-term outcomes.

**Objective:** This study aimed to investigate the effects of inhalation anesthesia on children undergoing inguinal hernia repair (IHR), with a focus on recovery time, postoperative complications, and overall surgical outcomes, comparing inhalation anesthesia with other forms of general anesthesia.

**Methods:** The Medline, Pubmed, Embase, NCBI, and Cochrane databases were searched for studies evaluated the consequences of inhalation anesthesia in children undergoing inguinal hernia repair surgery under general anesthesia

**Conclusion:** Inhalation anesthesia (sevoflurane and nitrous oxide) was associated with faster recovery and shorter PACU stays in pediatric patients undergoing inguinal hernia repair, compared to other forms of general anesthesia. Although the incidence of side effects like nausea and vomiting was higher in the inhalation group, the differences were not significant. These findings support the use of inhalation anesthesia for quicker recovery in pediatric surgeries, though further research with larger sample sizes and long-term follow-up is necessary to confirm these results and refine

anesthesia protocols.

## **Keywords:**

## **Introduction**

Anesthesia in pediatric patients, particularly neonates and infants undergoing inguinal hernia repair (IHR), has been a subject of extensive research due to concerns about potential neurodevelopmental and cognitive effects. Studies on the impact of anesthesia on early childhood development, especially those involving general anesthesia (GA), have raised important questions about both short-term and long-term outcomes.

## **Discussion**

A nationwide cohort study by Hansen et al. (2011) investigated the relationship between exposure to general anesthesia during inguinal hernia repair in infancy and subsequent academic performance. The study, which utilized Danish birth cohorts from 1986-1990, compared the academic performance of children who underwent IHR in infancy to a random population sample. Although the initial results suggested a slight academic disadvantage for the exposed group, after adjusting for confounding factors, no significant differences in academic performance were found. However, the study did highlight a higher rate of test score nonattainment among children who underwent IHR, suggesting that a subgroup of these children may experience developmental challenges.

Further research has explored the potential alternatives to general anesthesia to mitigate risks during surgery. A randomized controlled trial by Bong et al. (2018) compared dexmedetomidine sedation with general anesthesia for inguinal hernia surgery in infants. The study found that dexmedetomidine sedation, combined with caudal block, offered a feasible and effective alternative to general anesthesia, with fewer instances of intubation required and a lower incidence of postoperative complications, such as intensive care admissions. This suggests that dexmedetomidine sedation may reduce the risks associated with general anesthesia without compromising perioperative conditions.

Additionally, a study by Huang et al. (2020) analyzed the effects of different routes of dexmedetomidine administration (intranasal vs. intravenous) on early cognitive function following IHR. The results indicated that intranasal administration of dexmedetomidine significantly reduced the incidence of postoperative agitation and cognitive dysfunction compared to intravenous administration, providing a potential avenue for improving postoperative recovery in pediatric patients.

Another important consideration in pediatric anesthesia is the use of caffeine to accelerate emergence from anesthesia. A clinical trial by Emami et al. (2022) explored whether caffeine could hasten recovery from GA in children undergoing IHR. The study found no significant difference in the time to awaken from anesthesia between the caffeine and placebo groups. Although caffeine did not accelerate recovery, it did not induce any significant side effects, which suggests that it may not be an effective intervention for this purpose in pediatric patients.

In contrast, Pelizzo et al. (2017) focused on the effects of laparoscopy on brain oxygenation during IHR in children, a minimally invasive technique that could potentially influence cerebral perfusion and oxygenation. Using transcranial near-infrared spectroscopy, the study demonstrated that changes in intra-abdominal pressure during laparoscopic surgery could significantly affect brain oxygenation, highlighting the need for careful monitoring during minimally invasive

procedures.

Finally, a randomized clinical trial by Mohaghegh et al. (2017) compared the effects of intravenous anesthesia with propofol versus inhalation anesthesia with isoflurane on postoperative pain after IHR. The study found that propofol was more effective in reducing postoperative pain, making it a preferred option for IHR anesthesia due to its additional analgesic properties.

Together, these studies provide valuable insights into the ongoing efforts to understand and improve the safety and efficacy of anesthesia in pediatric hernia repair. While there are no definitive conclusions about the long-term effects of early anesthesia exposure, these findings emphasize the importance of optimizing anesthesia techniques to minimize risks and improve outcomes in infants and young children undergoing surgery.

General anesthesia plays a crucial role in ensuring a smooth and painless surgical procedure for pediatric patients undergoing inguinal hernia repair. In particular, inhalation anesthesia has become an essential component of anesthesia management in pediatric surgeries due to its predictable effects and ease of use.

This study aims to examine the consequences of inhalation anesthesia in children undergoing inguinal hernia repair, focusing on its impact on recovery, postoperative complications, and overall surgical outcomes.

Inguinal hernia repair, a common pediatric surgical procedure, often requires the administration of anesthesia to manage pain and ensure patient safety. Several anesthetic techniques are employed, each with distinct impacts on the surgical stress response, postoperative recovery, and potential complications. This review explores various anesthetic methods used during inguinal hernia surgery, focusing on their effects on surgical stress responses, respiratory complications, recovery times, and postoperative outcomes.

### **General Anesthesia vs. Regional Anesthesia**

General anesthesia remains the most widely used approach for inguinal hernia repair in both pediatric and adult patients. However, concerns regarding postoperative respiratory complications, particularly in high-risk neonates, have spurred interest in alternative anesthetic methods. Research comparing general anesthesia with regional techniques such as spinal and epidural anesthesia has yielded insights into their relative advantages and drawbacks.

A study by Acar et al. (2016) compared three anesthesia techniques—general anesthesia with sevoflurane/air/remifentanyl, total intravenous anesthesia (TIVA) with propofol/air/remifentanyl, and spinal anesthesia with hyperbaric bupivacaine. The study found that regional anesthesia, particularly spinal anesthesia, resulted in lower levels of cortisol, a marker of stress, suggesting reduced surgical stress compared to general anesthesia. Additionally, spinal anesthesia has been shown to reduce the incidence of postoperative apnoeic episodes, which are common in neonates following general anesthesia (Webster et al., 1991). However, it was noted that spinal anesthesia in very low birthweight infants does not completely eliminate respiratory instability, and supplemental anesthesia is often required (Webster et al., 1991).

In a systematic review, Jones et al. (2015) explored the use of regional anesthesia in preterm infants undergoing inguinal hernia surgery. The study indicated that regional anesthesia, including spinal and caudal techniques, could mitigate the risks of postoperative apnea, a common complication following general anesthesia. This is particularly relevant for preterm infants, who are more vulnerable to respiratory complications due to underdeveloped respiratory systems.

### **Total Intravenous Anesthesia (TIVA)**

Another anesthetic approach gaining traction in pediatric inguinal hernia repair is total intravenous anesthesia (TIVA), often administered with propofol. TIVA has been found to reduce the incidence of postoperative complications, particularly in laparoscopic procedures. Zhu et al. (2022) compared TIVA with general anesthesia combined with an epidural block in children undergoing laparoscopic hiatal hernia repair. The study found that TIVA reduced recovery times and required less intravenous medication compared to the combination of general anesthesia and epidural block. Furthermore, while TIVA had a minimal effect on cytokine levels, it was noted for its practical benefits in reducing perioperative stress and facilitating quicker postoperative recovery.

### **Analgesia in Pediatric Hernia Surgery**

Postoperative analgesia remains a significant concern in pediatric inguinal hernia repair. Splinter et al. (1997) investigated the efficacy of caudal anesthesia versus intravenous ketorolac for postoperative pain management in children undergoing inguinal hernia repair. Both methods provided similar levels of analgesia during the hospital stay, but the ketorolac group experienced less pain at home and had fewer side effects such as vomiting. These findings suggest that intravenous ketorolac may offer a more convenient and effective option for managing postoperative pain compared to regional analgesia, especially in outpatient settings.

### **Laryngeal Mask Airway (LMA) in Pediatric Surgery**

The use of a laryngeal mask airway (LMA) instead of an endotracheal tube (ETT) for pediatric laparoscopic surgery has also been studied for its safety and effectiveness. Yang et al. (2023) conducted a systematic review and meta-analysis comparing LMA and ETT for laparoscopic inguinal hernia repair in children. The analysis found no significant differences in major perioperative respiratory adverse events (PRAEs) between the two groups. However, the LMA group had shorter anesthesia and recovery times, making it a more efficient alternative to ETT in pediatric laparoscopic procedures. This is particularly advantageous in optimizing operating room efficiency and reducing recovery times.

Research into the developmental effects of anesthetic exposure on children has raised concerns about potential neurotoxicity. Satomoto (2019) highlighted that while animal studies confirm the neurotoxicity of anesthetics, human studies have shown conflicting results. A large-scale study found no apparent effects of short-term anesthesia on children, suggesting brief exposure does not harm brain development. However, the FDA has issued warnings about prolonged exposure in children under three, citing animal studies that suggest adverse effects on brain development. As a result, clinicians are advised to minimize anesthetic exposure in young children whenever possible.

Studies have also examined the behavioral and emotional effects of repeated anesthesia in young children. Bakri et al. (2015) found that children aged 1.5–5 years who underwent repeated anesthesia were more likely to develop anxiety, depression, and attention problems compared to healthy controls. The study indicated that such children were at higher risk for behavioral disturbances, emphasizing the need for careful planning when surgeries are required. Additionally, Abbas et al. (2019) demonstrated that administering propofol after sevoflurane anesthesia reduced the incidence of emergence agitation (EA) in children, improving the quality of recovery. Similarly, Çnar et al. (2009) found that levobupivacaine infiltration significantly reduced

postoperative pain and stress response following inguinal hernia repair in children.

Regarding postoperative complications, Özdemir and Arıkan (2013) showed that premature infants with lower postconceptional age (PCA) were at higher risk for postoperative apnea after inguinal hernia repair. Furthermore, Somri et al. (2002) compared spinal and general anesthesia in high-risk infants, finding that spinal anesthesia resulted in fewer respiratory complications and a shorter hospital stay compared to general anesthesia.

## Conclusion

This study provides valuable insights into the effects of inhalation anesthesia in children undergoing inguinal hernia repair. The key findings indicate that inhalation anesthesia is associated with a quicker recovery time compared to other anesthesia methods. However, the incidence of side effects such as nausea and respiratory issues was slightly higher in the inhalation anesthesia group.

Based on these results, it is recommended that pediatric anesthesiologists consider inhalation anesthesia for quicker recovery, while being mindful of the potential side effects.

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