

Caudal anesthesia as an alternative for the correction of anorectal defets in children

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Keypoints

General anesthesia in combination with a caudal block is an effective, safe method of anesthesia for complex surgical interventions for anorectal malformations in newborns and young children.

Abstract

Anorectal malformations are among the most common congenital malformations in children, occurring at a frequency of 2-5 per 10,000 births. Surgical correction for anorectal malformations is a significant operation, accompanied by severe pain.

Of the 35 children included in the study, 10 children were assigned to group I (general anesthesia) and 25 children to group II (general anesthesia + caudal block).

Hemodynamic parameters during surgery in the group of general anesthesia + caudal block were more stable than in group I (general anesthesia). There was no significant difference in the incidence of side effects (including laryngospasm, restlessness, nausea and vomiting) between the two groups I (33%) vs II (24.2%). When assessing postoperative pain using the FLACC scale, it was found that in the group of general anesthesia + caudal block, pain appeared only 6 hours after surgery than in the group of general anesthesia (1 hour after surgery), but there were significant differences between the two groups after 12 and 24 hours after the operation was absent.

General anesthesia in combination with a caudal block is an effective, safe method of anesthesia for complex surgical interventions for anorectal malformations in newborns and young children. This technique allows to

reduce the duration of the operation and improves the postoperative period.

Keywords

anorectal defects, caudal anesthesia, general anesthesia.

Introduction

Anorectal malformations are among the most common congenital malformations in children, occurring at a frequency of 2-5 per 10,000 births [1]. Surgical correction for anorectal malformations is a significant operation, accompanied by severe pain. All surgical interventions, including operations for the correction of anorectal defects, are accompanied by the development of a stress reaction, which is caused both by local tissue damage and by the activation of metabolic and neurohumoral defense mechanisms. Clinical manifestations of the stress response during surgery are changes in heart rate and blood pressure, which are caused by activation of the sympathetic autonomic nervous system and a massive release of catecholamines. Surgical interventions cause various endocrine, immunological, neurovegetative changes in the patient's body. The totality of endocrine, inflammatory and metabolic changes in response to surgical intervention is a surgical stress response. Sympathetic nervous system activation, pituitary hormone secretion, insulin resistance, cytokine production, and neutrophilic

leukocytosis form the basis of the surgical stress response. Consequently, the surgical stress response causes intra- and postoperative dysfunction of various organs and systems, which increases postoperative complications and lengthens the rehabilitation period. In surgical interventions for malformations of the anorectal region in newborns, regional methods of anesthesia are widely used, which have many advantages. The combination of general anesthesia and regional blockade provides the best conditions for the surgeon and helps to reduce intraoperative blood loss. When using regional blockade, there is a more rapid recovery of bowel function, in contrast to opiates, which increase the tone of the smooth muscles of the gastrointestinal tract and suppress peristalsis. The international guidelines for the perioperative management of newborns requiring bowel surgery also indicate that regional techniques, namely caudal anesthesia, are the best option for anesthesia. Caudal blockade significantly reduces the growth of cortisol and glucose in the blood plasma during traumatic operations for anomalies of the anorectal part of the body. Newborns exposed to the intense pain of these surgeries are at high risk for neurodevelopmental disorders and changes in pain sensitivity. Despite the increase in the frequency of colorectal operations in newborns and their severity, the choice of the optimal anesthetic support is still relevant and the subject of discussion. Until relatively recently, anesthesia using opioids has been the gold standard. Currently, regional anesthesia is becoming more widespread, which is increasingly becoming a routine method of analgesia in young children with colorectal malformations. The anesthetic allowance has an impact on the course and outcome of the postoperative period. Insufficient analgesia in the perioperative period can lead to the development of encephalopathy in the future [3]. Drugs used for general anesthesia have a specific effect on the body of the newborn. Newborns and young children are characterized by increased sensitivity of the respiratory system to opioids. One of the reasons that increase the sensitivity of newborns to opioids, with the exception of

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remifentanyl, is the reduced rate of their excretion in children during the first three months of life, and especially in premature infants. In children aged 3-6 months of life, a similar effect was not found [2].

Currently, the issue of the advantages and disadvantages of using total intravenous anesthesia as an alternative to inhalation anesthesia remains debatable. It has not been fully resolved which of the drugs for intravenous anesthesia was optimal in newborns and young children - propofol, midazolam or dexmedetomidine. An important place in the modern anesthetic management of anorectal malformations belongs to regional methods, caudal anesthesia has become widespread. The high risk of death during general anesthesia is associated with the possible development of respiratory complications in the postoperative period. The use of regional anesthesia in combination with general anesthesia not only reduces the incidence of adverse outcomes, but is also characterized by high economic efficiency by reducing the length of the patient's stay in the hospital. The reduction of perioperative pain in patients operated on for anorectal malformations is achieved using minimally invasive laparoscopic technologies.

Caudal block reduces the stress response to surgery and provides excellent postoperative pain relief with no or minimal need for narcotic analgesics, thereby reducing the risk of postoperative hypoventilation and apnea. Newborns tolerate high levels of regional blockade up to the Th₄ level without hemodynamic compromise. A caudal block is ideal for surgery because infants with anorectal anomalies may have concomitant spinal cord anomalies. Caudal block is one of the preferred regional anesthetics for anorectal malformations, and its advantages include simplicity, safety, and low complication rate. Caudal blocks can reduce the excitability of sympathetic nerves and have the same obvious effects of analgesics and muscle relaxants, facilitating surgery and promoting postoperative recovery. Currently, little research is available on caudal block for anorectal malformations. We hypothesized that general anesthesia combined with

a caudal block could effectively relax the anal muscles, which significantly reduces the complexity of the operation and shortens the duration of the operation. In this study, we evaluated the effect of caudal blockade on the duration of the operation and on postoperative pain relief. Thus, anorectal malformations are an actual problem of modern pediatric surgery. Despite the significance of the problem, at present the tactics of anesthetic management, the choice of the optimal anesthetic method are not fully defined, which requires further research.

Material and Methods

The study was conducted in the surgical clinic of the AMU. The study included 35 children aged 0 to 3 years at risk of ASA class II anesthesia. The structure of surgical pathology in which multimodal combined anesthesia was performed was: atresia or stenosis of the rectum, rectourethral fistula, vestibular fistula, rectovaginal fistula, etc. Depending on the method of anesthesia, the patients were divided into two groups: group I - patients with general anesthesia and group II - general anesthesia in combination with caudal blockade. The anesthesia protocol was the same for patients of group I: premedication was carried out only in children aged 1-3 years with midazolam at a rate of 0.4 mg/kg per os 20 minutes before surgery, anesthesia was induced with sevoflurane according to the "step-by-step" method using the Dräger Fabius apparatus according to semi-closed circuit at 5-6 vol% (MAC 1.5-2.5 vol%) for 3-5 minutes, followed by tracheal intubation with rocuronium bromide 0.6 mg/kg, fentanyl 5 µg/kg, and sevoflurane 3 vol% (MAC 1.2-1.5%). And in patients of group II - general anesthesia in combination with caudal blockade, the protocol of anesthesia was as follows: induction of anesthesia was carried out with sevoflurane according to the "step" method using the Dräger Fabius apparatus in a semi-closed circuit at 5-6 vol% (MAC 1.5-2.5 vol. %) for 3-5 minutes, followed by tracheal intubation without the introduction of muscle relaxants and the supply of sevoflurane 3 vol% (MAC 1.2-1.5%). Then, a puncture of the caudal space was performed with a bolus injection of 0.25%

ropivacaine at a rate of 1.0 ml/kg in combination with dexamethasone 0.1 mg/kg. There were no complications during the caudal block. The hypnotic effect of anesthesia throughout the operation was achieved using sevoflurane 0.8 vol%. In the intraoperative period, almost no analgesics and muscle relaxants were used. The duration of the surgical intervention averaged 94±10 minutes. Intraoperatively and in the postoperative period, heart rate, blood pressure (systolic, mean, and diastolic), SaO₂, gas exchange parameters, glycemia, and cortisol concentration were monitored). After waking up, the pain syndrome was assessed according to the visual analogue, verbal and mimic scales for assessing the intensity of pain. Hemodynamic changes (including heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP)) were recorded before induction of anesthesia, at the beginning of the operation, at the most traumatic moment of the operation, and at the end of the operation. Postoperative pain intensity was assessed using the Face, Legs, Activity, Cry, Comfort Scale (FLACC), which assesses pain intensity by assessing five types of behavior (face, legs, activity, comfort, cry) to give a score range of 0 to 10 and each score on the scale has a possible value between 0 and 2. When assessing pain intensity, a scale of 10 indicates maximum pain, 0 indicates relaxation/comfort, 1-3 indicates mild discomfort, 4-6 indicates moderate pain, and 7-10 indicates severe discomfort. Pain assessment using the FLACC scale was also performed 1, 6, 12, and 24 hours after surgery. The incidence of side effects after extubation, including laryngospasm, restlessness, nausea and vomiting, was compared between the two groups.

The obtained quantitative and qualitative data were subjected to statistical processing by biostatistical methods: variational (t-Student, U-Mann-Whitney, KU-Kruskal-Wallis), dispersion (test ANOVA, F-Fisher) and discriminant (Pearson Chi-Square) analyzes using statistical packages EXCEL-2013 and SPSS-21.



Figure 1. Anus atresia



Figure 2. Transanal endorectal bowel resection in Hirschsprung disease

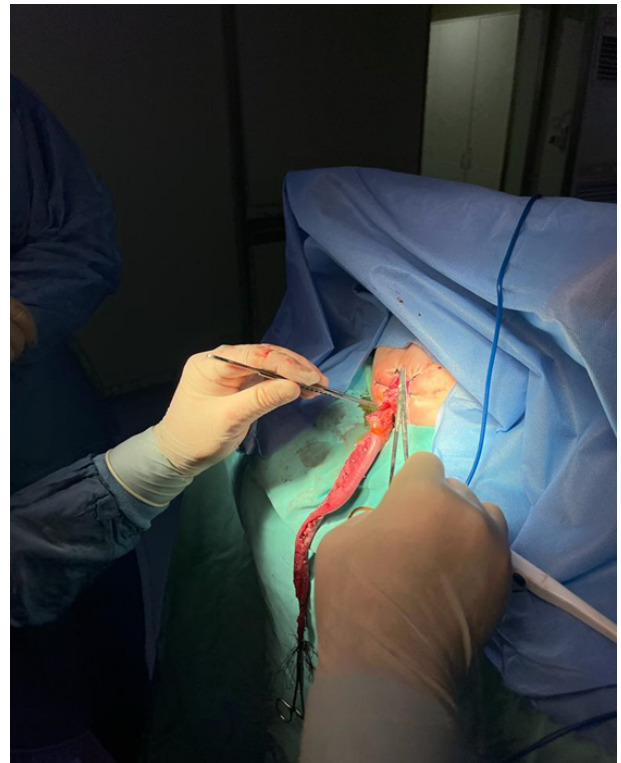


Figure 3. Transanal endorectal bowel resection in Hirschsprung disease



Figure 4. Caudal anesthesia for atresia with anus atresia



Figure 5. Caudal anesthesia for atresia with anus atresia



Figure 7. Caudal anesthesia for atresia with anus atresia

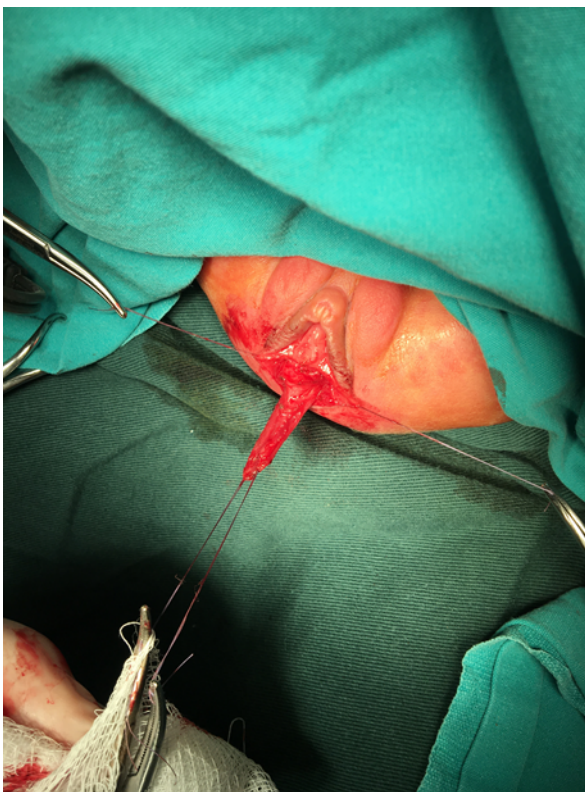


Figure 6. Caudal anesthesia for atresia with anus atresia

Research results

Of the 35 children included in the study, 10 children were assigned to group I (general anesthesia) and 25 children to group II (general anesthesia + caudal block). Patient demographics are shown in Table 1. Patients in both groups were comparable in age, sex and weight. When comparing the duration of the operation, it was found that II the group (general anesthesia + caudal block) had a significantly shorter operation time (94 minutes vs. 84 minutes $P = 0.040$). The recovery time after extubation in the general anesthesia + caudal block group was significantly shorter than in the general anesthesia group (17.05 ± 4.7 min vs. 10.79 ± 4.2 min, $P < 0.01$). Hemodynamic changes (HR, SBP and DBP) during operations between the two groups were similar before intubation and at the beginning of the operation ($P > 0.05$). During the traumatic moment of the operation, the average heart rate in group II (general anesthesia + caudal block) was significantly lower than in group I (general anesthesia)

(130.72±17.74 versus 115.28±16.19, $p=0.010$), but there are significant differences in SBP or DBP between the two groups. Thus, hemodynamic parameters during surgery in the group of general anesthesia + caudal block were more stable than in group I (general anesthesia). There was no significant difference in the incidence of side effects (including laryngospasm, restlessness, nausea and vomiting) between the two groups I (33%) vs II (24.2%), ($P>0.05$). When assessing postoperative pain using the FLACC scale, it was found that in the group of general anesthesia + caudal block, pain appeared only 6 hours after surgery than in the group of general anesthesia (1 hour after surgery), but there were significant differences between the two groups after 12 and 24 hours after the operation was absent ($P>0.05$).

Variables	Group I (n=10)	Group II (n=25)	P
Age, month, mean (range)	4.50 (3.1,5.8)	5.50(3.04, 6.01)	0.412
Gender	19/11	28/7	0.537
Weight, kg, mean (range)	8.14(3.1,9.5)	8.25(4.91,7.60)	0.513

Table 1. Demographic characterizes

Discussion

The present study shows that caudal blockade in combination with general anesthesia can be successfully used in surgical interventions for anorectal malformations in newborns and young children. General anesthesia can cause hemodynamic and respiratory complications during the perioperative period, as well as potential neurotoxicity [4, 5]. The combination of general anesthesia and caudal block reduces the neurohumoral response to surgery, alleviates intraoperative inhalation and consumption of opioid agents, and accelerates early mobilisation and recovery [6]. The high incidence of life threatening respiratory complication after general anesthesia decreased after awake regional anesthesia. Suresh et al. investigation of 18, 650 children who received caudal block *Sultanova et al. Caudal anesthesia in children*

showed that the incidence of complications was 1.9% (1.7%—2.1%), demonstrating that the procedure is safe and should be widely used [7, 8].

On the other hand, general anaesthesia is regarded to be safe, but the risk of postoperative apnoea and hypoxaemia is not negligible in infants who are born preterm and operated upon before 46 weeks of post-conceptual age. The probability of apnoea in these patients may be up to 20%, especially in infants with a post-conceptual age, 45 weeks. The rate of apnoea in our patients was very low, and no difference between infants, who are born preterm or operated upon before 46 weeks of postconceptual age, and children was observed.

The spinal column of children is straight, while epidural adipose tissue, lymphatic vessels, and vascular plexus are abundant, and the sacral canal volume is small. The anesthetic injected into the sacral canal easily spreads to the thoracic epidural space, and the block area can reach the level of 6–8 thoracic vertebrae. The analgesic and muscle relaxant effects of anesthetics not only satisfy the requirements of transanal operation, but also reduce the draw reaction during laparoscopic surgery, and provide more stable hemodynamics. An optimal analgesic effect can avoid the stimulation of the sympathetic adrenal medulla and reduce the release of catecholamine, as well as reduce the irritation caused by tracheal intubation, skin incision and transanal operation. Šabanović Adilović et al. found that caudal block with analgo-sedation provide better control of intraoperative hemodynamic conditions, postoperative emergence delirium and postoperative pain compared with general endotracheal anaesthesia [9]. In our study, the II group received general anesthesia combined with caudal block, and the hemodynamic changes during transanal operation were more stable than those in the I group.

The FLACC scores at 1 h and 6 h after surgery and the mean dose of sufentanil were lower, suggesting that general anesthesia combined with caudal block can provide better analgesic effect. The duration of operation, and in particular that of transanal operation of the II group were

significantly shorter, and we don't use rocuronium than that in the I group, indicating that the caudal block could effectively relax the anal muscles.

Alizadeh's study [10] indicated that caudal block in addition to general anesthesia had a favorable effect on reducing blood loss during operation, operation duration, and analgesic use, agreement with our findings.

Kim et al. found that caudal block significantly reduced the sevofurane concentration for a smooth laryngeal mask airway removal in anesthetized children, reduced airway complication and led to faster recovery [11]. In the II group, the recovery time was shorter, which may be due to the lower mean doses rocuronium. A previous study found that caudal block could provide a more effective and lasting analgesic effect, but was associated to more side effects than general anesthesia [12]. Another study suggested that caudal block was not associated with postoperative side effects [13,14,15,16]. However, in our study we found no differences in the incidence of complications between the two groups.

Conclusion

General anesthesia in combination with a caudal block is an effective, safe method of anesthesia for complex surgical interventions for anorectal malformations in newborns and young children. This technique allows to reduce the duration of the operation and improves the postoperative period.

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