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Research Article

The Choice of Anesthesia for Reconstructive Surgery in Children with Cerebral Palsy

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Abstract

Introduction: The selection of the optimal method of anesthesia for reconstructive surgery for cerebral palsy remains relevant to this day.

Aim of the Study: To optimize anesthetic management in children with cerebral palsy based on balanced intravenous anesthesia and caudal block.

Materials and Research Methods: Our work is based on research and analysis of anesthesia in 27 patients aged 3 to 11 with a diagnosis of cerebral palsy in the form of spastic diplegia of moderate and severe severity, operated routinely in the AMU surgical clinic for the period from 2014 to 2019. The main method of analgesia in children with cerebral palsy is general anesthesia using muscle relaxants, narcotic analgesics and mechanical ventilation. Caudal anesthesia during these operations is not an alternative and routine practice. Induction of anesthesia in the general anesthesia group was carried out with propofol at a rate of 3 - 4 mg/kg, and maintenance of anesthesia with an inhaled anesthetic isoflurane and narcotic analgesic fentanyl. Intubation was carried out after administration of esmeron of 0.6 mg/kg. In the group of patients with caudal blockade, induction and maintenance of anesthesia was carried out only with propofol using a Brown syringe pump. After the patient was completely asleep, the caudal block was turned over onto the left side. A mixture of local anesthetics ropivacaine 4 mg/kg and dexamethasone 0.1 mg/kg was injected into the caudal canal.

Conclusion: Patients with cerebral palsy in the form of spastic diplegia during surgery under general anesthesia are characterized by arterial hypotension, tachycardia and the difficulty of transferring from artificial lung ventilation to spontaneous breathing. General anesthesia with artificial ventilation of the lungs based on propofol and fentanyl additionally violates hemodynamics due to the cardiodepressive effect of the drugs used. General anesthesia does not provide adequate protection against surgical stress. As evidenced by an increase in glucose and cortisol by 2.5 times. In the early postoperative period, the intensity of pain in children after general anesthesia was characterized as very strong and occurred immediately after the patient was transferred to the ward.

Caudal blockade provides adequate perioperative analgesia, comfort and the absence of lower limb muscle spasticity in the early postoperative period and stable central hemodynamics throughout the perioperative period.

Keywords: *Cerebral Palsy; General Anesthesia; Caudal Anesthesia*

Introduction

The selection of the optimal method of anesthesia for reconstructive surgery for cerebral palsy remains relevant to this day. Methods of regional anesthesia in children with cerebral palsy are used relatively recently and are not a routine practice [2,3,9,10]. This is explained by the presence of relative contraindications, found in many sources. However, cerebral palsy does not apply to either degenerative or

progressive diseases of the nervous system, and muscle spasticity is the result of intranatal brain damage [1,4-8]. Therefore, regional blockades should not worsen the course of the underlying disease.

Aim of the Study

To optimize anesthetic management in children with cerebral palsy based on balanced intravenous anesthesia and caudal block.

Materials and Research Methods

Our work is based on research and analysis of anesthesia in 27 patients aged 3 to 11 with a diagnosis of cerebral palsy in the form of spastic diplegia of moderate and severe severity, operated routinely in the AMU surgical clinic for the period from 2014 to 2019. In patients with cerebral palsy at the age of 3 - 7 years, the area of the surgical intervention is more often the region of the upper third of the thigh and the hip joint. Due to the pronounced muscle spasticity, children of this age group do not walk for a long time, as a result of which there are diplastic changes in the hip joints, and this requires correction either by osteotomy of the femur, or by muscle myotomy of the upper third of the thigh. In older children, tendon-muscle plate operations are performed to eliminate contractures in the area of the knee joints and foot.

To date, the main method of analgesia in children with cerebral palsy is general anesthesia using muscle relaxants, narcotic analgesics and mechanical ventilation. Caudal anesthesia during these operations is not an alternative and routine practice. During the study, all patients were divided into two groups depending on the method of analgesia: general and caudal anesthesia. Premedication in all patients was the same: 30 minutes before the operation, midazolam was administered intramuscularly at a rate of 0.4 mg/kg in the ward. Induction of anesthesia in the general anesthesia group was carried out with propofol at a rate of 3 - 4 mg/kg and maintenance of anesthesia with an inhaled anesthetic isoflurane and narcotic analgesic fentanyl. Intubation was carried out after administration of esmeron of 0.6 mg/kg. In the group of patients with caudal blockade, induction and maintenance of anesthesia was carried out only with propofol using a Brown syringe pump. After the patient was completely asleep, the caudal block was turned over onto the left side. A mixture of local anesthetics ropivacaine 4 mg/kg and dexamethasone 0.1 mg/kg was injected into the caudal canal.

Results and Discussion

In the group of patients with general anesthesia, after induction against the background of the vasoplegic action of propofol and fentanyl, the ADsred decreased by 25% ($p < 0.05$) and the SPS to 30% ($p < 0.05$). These changes were not accompanied by a compensatory increase in heart rate, and despite this, the cardiac index remained stable. Maintaining a normal cardiac output under conditions of reduced vascular tone and volume of circulating blood was due to our chosen volume of infusion support. With the beginning of the operation, the heart rate slowed down by 10 - 12% and the average blood pressure and total peripheral vascular resistance remained below the initial values. At the most traumatic time of the operation, in this group of patients there were signs of a decrease in blood circulation efficiency, expressed in a tendency to a decrease in the heart index by an average of 10% against a background of a decrease in heart rate. At the same time, mean arterial pressure and total peripheral vascular resistance increased, which can be explained by the reaction to the breakthrough of nociceptive impulses from the area of the surgical wound. The end of the operation was characterized by the stability of the studied parameters and this was facilitated by the replenishment of the circulating blood volume due to infusion therapy of 20 ml/kg/hour and the patient's return to the physiological position on the back. An indicator of the quality of the patient's protection from operational stress, in addition to hemodynamic changes, are the blood glucose levels of cortisol, which were determined using enzyme-linked immunosorbent assays. After the operation, in children of this group there was a significant, more than 2.5-fold increase in the level of glucose of cortisol compared to the initial data. The period of recovery from anesthesia was characterized by a rather short recovery period. All patients in this group were extubated during the first 10 - 15 minutes after stopping the supply of isoflurane, and 20 minutes after extubation the level of consciousness on the Aldrete scale was more than 7 points. It should be noted that the disappearance of signs of lethargy and the appearance of independent movements in patients led to a rapid generalization of muscle spasticity, which in turn caused the appearance of crying due to pain in the area of the operation. Therefore, general anesthesia in patients with cerebral palsy is associated with a significant risk of both intra- and early postoperative hemodynamic instability. This is explained by the fact that patients

with cerebral palsy due to their illness have hemodynamics characterized by tension and paradoxical reactions to the load, and general anesthesia additionally has a depressing effect on the circulatory system. An increase in the level of glucose and cortisol in the postoperative period suggests an insufficient antinociceptive protection of general anesthesia. Therefore, the need to increase doses of opioids will lead to an increase in their depressive effect on hemodynamics.

Therefore, it became necessary to develop an alternative method of analgesia with a high degree of antinociceptive protection and a controlled effect on hemodynamics during surgical interventions in patients with cerebral palsy. In modern anesthesiology, regional blockades are an alternative to general anesthesia. To provide anesthetic benefits for patients with cerebral palsy, we preferred caudal anesthesia. Caudal blockade was carried out after the patient completely fell asleep with propofol. After caudal blockade, a decrease in mean arterial pressure by 15% and total peripheral vascular resistance by 12% was observed against the background of the absence of a compensatory increase in heart rate. Maintaining normal cardiac output, as in general anesthesia, was due to the fact that the inevitable decrease in vascular tone was actively compensated by intravenous infusion therapy, which allowed for sufficient venous return to ensure adequate cardiac output.

With the beginning of the operation, the heart rate began to slow down even more by 16%, and the average blood pressure by 22% compared with the initial data. At the most traumatic time of the operation, signs of a decrease in blood circulation efficiency were observed, associated with a decrease in heart rate by 20%, and average blood pressure by 16%. This was explained by the fact that caudal blockade causes a decrease in vascular tone, an increase in the capacity of the venous channel and a relative decrease in the volume of circulating blood, which requires correction by infusion therapy. Patients of this group woke up immediately after the operation. In the postoperative period, the pain intensity after general anesthesia was characterized as very strong and occurred almost immediately after the patient was transferred from the operating room to the ward. In patients after general anesthesia, the level of pain intensity, measured on a visually analogue scale, exceeded the values determined in the group with caudal blockade by 2.5 times ($p < 0.05$). Spasticity of the muscles plays a significant role in the picture of postoperative pain syndrome in patients, which worsens their general condition and requires additional administration of analgesics, sometimes even opioids in the postoperative period. After the operation in the group with caudal blockade, there was no restoration of spasticity of the muscles of the lower extremities, there were no complaints of pain for 12 hours. It should be noted that in patients of this group by 12 hours after surgery, the indicators of the level of pain intensity at rest and during movement were close to the minimum on a visually analogue scale of 1.8 ± 0.3. Effective blockade of pain stimulation both at rest and during movement, and the absence of a sedative effect, analgesia contributed to the early activation of patients in the group with caudal blockade, which allowed for a positive psycho-emotional background in children in the postoperative period. The use of a mixture of ropivacaine and dexamethasone for intraoperative blockade provided a prolonged sensory block for 12 hours. After 12 hours, the quality of analgesia was slightly lower, which required the introduction of analgesics.

In the course of the study, we did not note a single case of infectious and neurological complications associated with caudal blockade. Allergic and toxic reactions to the use of local anesthetics were also not detected in any patient. Of the side effects in the immediate postoperative period, urinary retention was more often observed - in 22% of patients.

Conclusion

1. Patients with cerebral palsy in the form of spastic diplegia during surgery under general anesthesia are characterized by arterial hypotension, tachycardia and the difficulty of transferring from artificial lung ventilation to spontaneous breathing. General anesthesia with artificial ventilation of the lungs based on propofol and fentanyl additionally violates hemodynamics due to the cardiodepressive effect of the drugs used. General anesthesia does not provide adequate protection against surgical stress. As evidenced by an increase in glucose and cortisol by 2.5 times. In the early postoperative period, the intensity of pain in children after general anesthesia was characterized as very strong and occurred immediately after the patient was transferred to the ward.
2. Caudal blockade provides adequate perioperative analgesia, comfort and the absence of lower limb muscle spasticity in the early postoperative period and stable central hemodynamics throughout the perioperative period.

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