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ANESTHETIC SUPPORT FOR HIGH-TECH OPERATIONS IN PEDIATRIC ORTHOPEDICS

Zhu Jiang[1],
Department of Anesthesiology, Hanyang Hospital Affiliated to Wuhan University of Science and Technology, Wuhan, Hubei Province, attending physician;
Ye Na[2],
Department of Anesthesiology, Hanyang Hospital Affiliated to Wuhan University of Science and Technology, Wuhan, Hubei Province, attending physician;

Corresponding author:
Ma Jun,
Department of Anesthesiology, Hanyang Hospital Affiliated to Wuhan University of Science and Technology, Wuhan, Hubei Province, deputy chief physician.

Method of anesthesia service of high-tech operations on children's lower extremities - extended regional anesthesia - has been developed and proved. It provides hemodynamics stability during operation, reduces donor transfusion demand, improves the course of post operation period and improves the quality of health care delivery.

Key words: children, operation, lower extremities, regional anesthesia.

Introduction

Active introduction of high-tech surgical interventions into the practice of NNIITO, including in pediatric orthopedics, requires an appropriate level of anesthesia. Currently, conduction anesthesia in children, and especially extended ones, has a very limited distribution in China. At the same time, methods are being actively developed abroad that make it possible to mobilize patients in the shortest possible time, including the use of prolonged regional anesthesia [1, 2, 3]. The most modern and objective method of quality control of conduction anesthesia is the use of ultrasound. This is especially true for children, when regional anesthesia cannot be performed while maintaining the patient's consciousness [4, 5, 6]. For operations on the hip joint, the method of choice is combined spinal-epidural anesthesia in combination with superficial anesthesia and preservation of spontaneous breathing. The choice is due to the following reasons: spinal anesthesia provides the best antinociceptive protection, but in children it has a limited duration of action (80–90 minutes) [7, 8]. Epidural anesthesia makes it possible to extend regional anesthesia for the required period.

Purpose of the study: to develop and justify methods of anesthesia during operations on the lower extremities in children.

Material and methods

The patients under observation (71) were divided into two groups: the first group included 27 children, aged from 4 months to 3 years, with foot pathology. The second group consisted of 44 patients aged 1 year 3 months. up to 17 years of age who underwent surgery on the pelvis, hip joint and thigh.

Anesthetic care for foot operations (first group)

To ensure intra- and postoperative pain relief, prolonged conduction anesthesia of the sciatic nerve was performed. For premedication, atropine was used at a rate of 0.01 mg/kg intramuscularly. Anesthesia was administered using sevoran using the rapid induction method. After achieving a sufficient level of anesthesia, a laryngeal mask was installed and sevoran inhalation was continued with spontaneous breathing. Then conduction anesthesia of the sciatic nerve was performed. The needle insertion point was located 1–1.5 cm caudal to the middle of the straight line connecting the top of the greater trochanter and the middle of the ischial tuberosity. Verification of the needle relative to the nerve trunk was carried out using an electrical stimulator Stimuplex HNS 12 (B. Braun) and ultrasound control with a Micromaxx device (Sonosite). The needle with the Contiplex-D catheter was directed caudally, at an angle of 30° to the surface. When plantar flexion of the foot and fingers was obtained, a 0.375% naropin solution was injected at a current strength of 0.4–0.5 mA, which provided an intraoperative blockade. A Perifix catheter was then inserted through the Contiplex-D catheter into the perineural space. The spread of the anesthetic and the passage of the catheter parallel to the sciatic nerve were monitored using ultrasound. After this, blockade n was performed. saphenus through the inguinal approach, since only this branch of the femoral nerve reaches the medial part of the foot, participating in the cutaneous innervation. The total dose of naropin was 3.3 mg/kg, with 2/3 of the volume injected to the sciatic nerve and 1/3 to the n. saphenus. Anesthesia was maintained with sevoran during spontaneous breathing. At the end of the operation, the supply of Sevoran was stopped, the laryngeal mask was removed, and awakening occurred after 3–5 minutes. In the postoperative period, an infusion of 0.2% naropin to the sciatic nerve was started using a syringe dispenser at a rate of 0.2 mg/kg/h. The duration of the infusion was 2–3 days. The catheter position was monitored in the postoperative period using ultrasound using a Micromaxx device (Sonosite). The effectiveness of the blockade was assessed using an AGEMA-470 thermal imager (Sweden) with standard service support (IRWIN 5.2), which allows real-time observation of vascular reactions in the autonomous zones of innervation (AZI) of the blocked peripheral nerves.

Anesthetic support for operations on the pelvis, hip joint and thigh (second group).

After premedication with atropine 0.01 mg/kg and relanium 0.15 mg/kg, induction anesthesia was performed. In the “Sevoran” subgroup (n=23), it was carried out using the “bolus” induction method. Then Dormicum was administered intravenously at a dose of 3.6±0.3 mg/kg. After reaching stage III1 anesthesia, a laryngeal mask was installed and sevoran inhalation was continued during spontaneous breathing with a minimum alveolar concentration (MAC) of 1.3–1.5. In the “propofol” subgroup (n=21), induction was carried out with a bolus injection of propofol at a dose of 3.8±0.3 mg/kg and fentanyl at a dose of 0.04±0.004 mg/kg. Spinal epidural anesthesia was performed as follows. In the position on the healthy side, under aseptic conditions, under local anesthesia with 1% lidocaine at level LII–LIII, puncture and catheterization of the epidural space was performed. The latter was identified using the loss of resistance method. The catheter was directed cranially 2–4 cm. Then, at the LIII–LIV level, spinal anesthesia was performed with 0.5% isobaric marcaine at a dose of 0.5±0.03 mg/kg. After 80.3±4.1 min. A 0.2% solution of naropin was injected fractionally into the epidural catheter at a dosage of 0.6 mg/kg and its infusion was continued at a rate of 0.3 mg/kg/hour (using this method a positive decision was received to issue a RF patent). Sevoran or propofol infusion was stopped after applying a plaster cast. Naropin infusion was continued for 3–4 days. To create "basic" analgesia, perfalgan was also used intravenously on the first day at a dose of 15 mg/kg every 6 hours.

Results First group. Induction of anesthesia proceeded without complications; in 98% of cases, the laryngeal mask was installed on the first attempt. One child had suppression of spontaneous breathing and an increase in end-exhaled carbon dioxide, which required mechanical ventilation. Catheterization of the perineural space of the sciatic nerve was successful in all cases. Table 1 shows the indicators of peripheral hemodynamics at the stages of the operation. On the day of surgery, two children required additional pain relief with promedol, one injection each. There was no further need for the use of narcotic and non-narcotic analgesics. No nausea or vomiting was observed in the postoperative period. Ultrasound control confirmed the location of the catheter near the sciatic nerve, as well as the spread of anesthetic into the perineural space. During thermal imaging examination on the first or second days of the postoperative period, the elevated temperature background of the distal segments of the operated leg remained, thermal asymmetry reached 3–11°C. In response to an alcohol test, temperature recovery in the AZ of blocked nerve branches occurred at an increased rate, usually in less than 1 minute, which was a sign of a complete shutdown of the sympathetic regulation of the vessels in them.

Table 1. Hemodynamic parameters at the stages of surgery in the first group (compared to the initial stage, Wilcoxon test)

Indicators	Stage							
	Original	Cut	min. 15	min. 30	min. 45	min. 60	min. 75	End operation
ADS	99,1± 4,9	80,0± 2,4	78,5± 2,6	75,9± 2,4	78,5± 2,2	74,2± 5	84,3± 2,6	81,0± 2,1
		p=0,01	p=0,001	p=0,0005	p=0,0009	p=0,002	p=0,04	p=0,0006
ADD	58,4± 4,2	43,3± 2	38,2± 2,5	41,0± 2,6	38,4± 2,4	38,9± 3	43,2± 1,6	43,0± 1,6
		p=0,001	p=0,001	p=0,006	p=0,001	p=0,002	p=0,04	p=0,002
HR	122,5± 7,5	116,9± 3,3	115,6± 3,5	114,2± 2,8	111,0± 2,9	112,7± 3,9	111,3± 4,8	110,0± 2,9
		p=0,4	p=0,02	p=0,01	p=0,009	p=0,05	p=0,06	p=0,01

Table 2. Hemodynamic parameters in the "Sevoran" subgroup of the second group (compared to the initial stage, Wilcoxon test)

Indicator	Stage					
	original	cut	Osteotomy 1	Osteotomy 2	End operation	In the ICU
ADS	113,8±4,9	82,3±2,3	81,3±2,2	81,3±3,6	86,6±1,9	95,1±2,8
		p=0,00008	p=0,00006	p=0,005	p=0,00006	p=0,0009
ADD	69,9±3,0	40,2±2,0	37,4±1,3	42,0±2,9	42,8±1,6	55,3±2,1
		p=0,00008	p=0,00008	p=0,00008	p=0,00008	p=0,00008
HR	110,9±4,0	116,3±3,3	113,8±2,6	113,5±3,8	108,6±3,0	116,2±4,2
		p=0,10	p=0,07	p=0,50	p=0,36	p=0,97

Table 3. Hemodynamic parameters in the propofol subgroup of the second group (compared to the initial stage, Wilcoxon test)

Indicator	«propofol»					
	original	cut	Osteotomy 1	Osteotomy 2	End operation	In the ICU
ADC	119,0± 2,9	86,2±2,35	83,3±2,3	91,1±4,4	94,9±2,5	100,0±4,3
		p=0,00009	p=0,00009	p=0,04	p=0,001	p=0,003
ADD	67,0± 2,8	43,2±1,8	39,8±3,4	45,8±3,5	48,9±2,5	55,7±4,3
		p=0,00008	p=0,00009	p=0,04	p=0,00009	p=0,05
HR	100,1± 4,7	93,7±3,5	94,0±3,1	100,8±6,0	95,3±3,0	102,9±4,2
		p=0,60	p=0,88	p=0,50	p=0,18	p=0,69

Table 4. Indicators of blood loss, infusion therapy and diuresis in the second group

Subgroup	Blood loss		Intraoperative infusion		Postoperative crystalloid infusion, ml/kg	Diuresis, ml/kg
	ml/kg	**%** OtsK	**0,9% S.NaCl** ml/kg	% voluven ml/kg		
«sevoran»	4,5±0,9	6,5±0,9	17,5±1,4	14,0±0,9 (n=13)	13,3±1,3	27,7±3,0
«propofol»	5,3±0,9	7,5±1,2	13,6±1,9	11,0±1,3 (n=14)	11,5±1,0	16,8±1,9

2nd group. All patients were able to insert an epidural catheter on the first attempt. There were also no difficulties with performing spinal anesthesia. One patient of the first group and three patients of the second group required additional administration of fentanyl, as a motor reaction to the incision was noted. In three patients of the first group, suppression of spontaneous breathing, bradypnea, and an increase in EtCO2 were noted, which required mechanical ventilation. Table 2 presents the indicators of peripheral hemodynamics at the main stages of the operation in the Sevoran subgroup. Table 3 shows hemodynamic parameters in the propofol subgroup. The initial stage was characterized by moderate stress hyperdynamia. Spinal-epidural anesthesia was effective in all patients, which is confirmed by hemodynamic indicators at the stages of the beginning of the operation and the performance of osteotomies. Since the duration of spinal anesthesia in children is limited, by the final stage of the operation the hemodynamic state characterized the effectiveness of the developed epidural block. As can be seen from Table 4, a low level of blood loss was noted in both subgroups; in some cases, transfusion of colloidal blood substitutes was not required. Accounting for postoperative blood loss was difficult, since only rubber graduates were installed in the wound. However, based on postoperative urine output, physical examination, and red blood counts, we concluded that fluid resuscitation was adequate. There was no need for transfusion of donor blood components. On the first day after surgery, the need for additional administration of promedol arose in 5 patients in the first group and 7 patients in the second group. The prescription of a narcotic analgesic was in part due to positional discomfort associated with the hip cast. It should be noted that in young children, objective assessment of pain was difficult. Due to concomitant neurological pathology, 5 children had hyperexcitability syndrome on the first postoperative day, which required sedative therapy. Epidural catheters were removed without complications on the 4th day. Vomiting was observed in 9 children of the first group and 6 children of the second group. Two patients (second group) experienced difficulty urinating, which required bladder catheterization in the postoperative period. Conclusion Prolonged regional anesthesia, being a necessary component when performing orthopedic operations in children, ensures hemodynamic stability during surgery, reduces the need for donor transfusions, improves the course of the postoperative period and improves the quality of medical care for children.

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