

Changes in the Central Hemodynamics in the Surgical Treatment of Glaucoma in Children under the Conditions of Combined Anesthesia

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Abstract In the surgical treatment of glaucoma in children under anesthesia protection, the maximum reduction in intraocular pressure (IOP) is required. Otherwise, there is a possibility of a dangerous complication - vitreous prolapse. In this article the combined use of inhalation anesthetic sevoflurane in the surgical treatment of glaucoma in children is discussed as a method of improving the anesthetic protection of children.

Keywords Surgical treatment, Anesthetic sevoflurane, Glaucoma, Intraocular pressure, Ophthalmic operations

1. Introduction

In the surgical treatment of glaucoma in children under anesthesia protection, the maximum reduction in intraocular pressure (IOP) is required, which minimizes the possibility of a dangerous complication - vitreous prolapse [1,2,9]. In addition, low intraocular pressure is a prerequisite for quite complex manipulations: suturing the iris, implanting an intraocular lens. In this regard, when providing anesthesia for intraocular operations, it is necessary to exclude the use of drugs that increase intraocular pressure. [3,4,8]. In addition, when conducting anesthesia during ophthalmic operations, the anesthesiologist should avoid excessive excitation of the patient, his cough and other actions that could increase intrathoracic, intraocular, systemic arterial pressure. [7,11,12].

Currently, inhalation anesthetics can meet all these requirements in pediatric anesthesia practice. In this regard, the use of inhalation anesthetic sevoflurane in combination with microdoses of fentanyl in glaucoma in children is the most relevant. [5,6,10].

The aim of the research: Improving the anesthetic protection of children by the combined use of inhalation anesthetic sevoflurane in the surgical treatment of glaucoma in children.

2. Materials and Methods

To provide anesthetic protection in 38 sick children during the surgical treatment of glaucoma, the following

combinations were used: fentanyl with sevoflurane (Group 1 - 52.63%), fentanyl with propofol (Group 2 - 47.37%). Children aged from 1 to 5 years old accounted for 57.89% of the total number of patients, children from 6 to 10 years old - 26.32% and children from 11 to 15 years old accounted for 15.79%.

Patients of the 1st group after premedication, induction was carried out by inhalation of sevoflurane up to 3 vol%. Small doses of fentanyl were administered intravenously - 0.008-0.01 mg/kg. Tracheal intubation was performed against the background of the introduction of arduan at a dose of 0.06 mg/kg. ALV was carried out by the apparatus "Boyle International-2" (USA) in a semi-open or semi-closed circuit. Myorelaxation was maintained by the introduction of 1/3 of the main dose of arduan. Anesthesia was maintained by inhalation of sevoflurane at a dose of 0.8 - 1.5 vol%. Infusion therapy was carried out at a rate of 5-7 ml/kg/h. After the end of the operation, with the advent of adequate spontaneous breathing, the trachea was extubated. After the operation, the patients woke up quite quickly, within 13.8±0.8 minutes.

During the induction period, patients of the 2nd group received bolus solutions of propofol at a dose of 3 mg/kg and fentanyl at a dose of 0.008-0.01 mg/kg. The dose of propofol during the maintenance of anesthesia averaged 7.3±0.4 mg/kg/h. Intraoperatively, infusion therapy was performed at a rate of 10 ml/kg/h. The duration of the awakening stage was 35.5±5.6 min.

The study of hemodynamics was performed on an Aloka SSD-260 echocardiograph (China) with a 3.5 MHz probe. Echocardiography (EchoCG) parameters were calculated automatically. The following values were determined: stroke index (SI) = SVR /S ml/m², cardiac index (CI) = MOC/S l (min*m²), specific peripheral resistance (SPR) =

SBP/SI in s. units Computer analysis of echocardiography made it possible to calculate indicators of myocardial contractility and diastolic function of the left ventricle.

Measurement of intraocular pressure was made according to A.N. Maklakov. Normal IOP is 16-23 mm. rt. Art. Patients had IOP measured before and after surgery. The results of clinical and functional studies were processed by the method of variation statistics Student's T-test.

3. Results of the Study and Their Discussion

The results of the study of hemodynamic parameters during combined anesthesia with the use of fentanyl and sevoflurane are presented in table 1.

Compared with the initial data on the premedication background, there was an increase in heart rate by 17.52% and a decrease in specific peripheral resistance (SPR) by

20.74%. Other indicators changed slightly. After the administration of fentanyl, hemodynamic parameters such as stroke index (SI), mean dynamic pressure (MDP), cardiac index (CI), ejection fraction (EF) and heart rate decreased compared with those of the premedication period, by 14.21% ($P<0.05$), 3.98%, 8.57%, 4.19% and 2.79%, respectively, excluding SPR. 10 minutes after intubation, there was an increase in SI by 20.44%, CI by 21.65%, and MDP by 8.53%, while at the same time, there was a decrease in SPR by 13.76% ($P<0.05$).

There was a trend towards a decrease in the index of the fraction of exile (FE). In the period of maintenance of anesthesia, certain changes in the parameters of central hemodynamics were also observed. Thus, at the stage of skin incision, compared with the previous period, there was a decrease in MDP by 6.52%, heart rate - by 8.49%, SI - by 12.84%. At the same time, there was an increase in the SPR by 13.44%.

Table 1. Hemodynamic parameters during combined anesthesia with the use of fentanyl and sevoflurane ($M\pm m$)

Parameters	Research stages ($n=10$)				
	Exodus	premedication	induction period of anesthesia	traumatic stage	end of operation
SI, ml/m ²	42,14± 0,99	39,34± 1,69	33,75± 0,96*	39,22± 2,11	41,33 ±1,04
MDP, mm. rt. st	74,63± 1,85	75,07± 1,92	72,08± 1,85	75,85± 2,13	74,58 ±2,24
heart rate, min* ¹	113,0± 6,64	132,8+ 5,9	129,1± 3,15	124,9± 6,15	117,7 ±5,89
CI, l/min X m ²	4,82± 0,41	4,9± 0,28	4,48± 0,29	4,66± 0,26	4,83± 0,27
SPR, r.u.	18,18± 1,57	14,41± 1,07	17,0± 0,73	17,63± 1,44	15,57 ±1,48
FE, %	62,73± 1,66	65,09± 2,89	62,36+ 2,7	63,19± 3,16	65,57 ±2,24

Note: * - reliability of differences in parameters compared to the initial value ($P<0,05$).

Table 2. Changes in hemodynamic parameters during general anesthesia with fentanyl in combination with propofol ($M\pm r$)

Parameters	Stages of surgery and anesthesia ($n=30$)				
	Exodus	Premedication	Induction period	Traumatic stage of operation	End of operation
SI, ml/m ²	47,26± 1,61	48,44± 1,59	46,5 8 ± 1,3	47,14± 1,41	47,3 8± 3,27
SBP, min ⁻¹	119,13± 1,82	126,81± 2,2*	119,06 ± 2,25	120,54± 2,06	123,94± 2,02
SI, l/min X m ²	4,73± 0,16	4,84± 0,16	4,66± 0,13	5,61± 0,23*	5,97± 0,51*
MDP, mm. rt. st	84,80± 1,94	85,53± 1,93	79,40± 2,00	82,87± 1,71	76,97± 1,18*
SPR, r.u.	68,29± 5,03	70,16± 5,39	68,36± 4,82	68,13± 5,05	72,72± 8,13
FE, %	63,76± 0,57	64,47± 0,72	63,84± 0,48	63,51± 0,55	63,73± 0,47

Note: * - significance of differences at $P<0.05$ compared with the initial value.

The stage of the traumatic moment of the operation was characterized by an increase in MDP by 3.72% and heart rate by 4.34%. Other indicators changed slightly. At the end of the operation, there were also minimal changes in parameters.

Under the influence of drugs for premedication in patients of group 2 (table 2), the following hemodynamic changes were noted:

an increase in heart rate by 6.45% ($P < 0.05$), with a trend towards an increase in SI by 2.5%, CI by 2.33%, SPR by 0.86%, UPS by 2.74% and FE by 1.11%.

Against the background of induction into anesthesia, slight changes in hemodynamic parameters were observed. There was a trend towards a decrease in the indicators of SI, SPR, CI and SBP, respectively, by 1.44%, 2.42%, 1.48% and 6.37%, a trend towards an increase in the indicators of SPR and FE, respectively, by 0.1% and 0, 13% ($P > 0.05$). Compared to similar indicators of the stage premedication showed a decrease in heart rate by 12.01%, SBP by 7.17% ($P < 0.05$).

At the traumatic stage of surgery, hemodynamic parameters differed slightly from those of the previous period. Only the CI indicator significantly increased by 20.39%, and compared with that of the initial period by 18.6%, in general, there was a stabilization of hemodynamic parameters.

At the end of the operation, hemodynamic parameters remained stable. The changes we found in the studied parameters were characterized by minor changes, except for the CI and SBP indicators. In relation to their initial value, there was some change, which was expressed by an increase in CI by 26.22%, a decrease in SBP by 9.23% ($P < 0.05$).

During anesthesia in the 1st group of patients in the postoperative period, there was only a tendency to a decrease in IOP by 13.43%, in the 2nd group - 7.44% (Table 3).

Table 3. Changes in IOP during various types of anesthesia in children

№	Type of anesthesia	IOP (mm Hg)	
		Before surgery	After operation
1	fentanyl + sevoflurane	26.8±1.67	21.2±1.37
2	fentanyl + propofol	24,2± 1,21	22,4± 1,39

4. Conclusions

1. A study of the response of the cardiovascular system to various options for general anesthesia and surgery in children with glaucoma revealed minor and compensated changes in the main hemodynamic parameters, which indicated effective anesthetic protection of the child's body from surgical trauma.
2. Anesthesia aids with microdoses of central analgesics - fentanyl with sevoflurane and fentanyl with propofol provide adequate pain relief while maintaining low IOP, which is the method of choice

for anesthesia in the surgical treatment of glaucoma in children.

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