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MONITORING OF CENTRAL HEMODYNAMICS UNDER CONDITIONS OF COMBINED ANESTHESIA WITH SEVOFLURAN IN SURGICAL CORRECTION OF CATARACT IN CHILDREN

I.A. Mamatkulov, E.A. Satvaldieva, A.S. Yusupov, B.T. Buzrukov, M.G. Tolipov

Tashkent Pediatric Medical Institute

Resume

Research purpose: Improvement of the methods of anesthetic management with the use of sevoflurane in the surgical treatment of cataracts in children.

Materials and methods: 54 sick children were studied during ophthalmosurgical interventions under combined anesthesia based on the use of sevoflurane.

Results and discussion: The data obtained from studies of central hemodynamic parameters showed minimal changes in the response of systemic hemodynamics, which were associated with the peculiarities of the pharmacological action of both fentanyl and sevoflurane. It should be noted that this condition during anesthesia characterized the state of moderate circulatory hypodynamia.

Keywords: anesthesia in children, inhalation anesthetics, sevoflurane, fentanyl, central hemodynamic parameters.

МОНИТОРИНГ ЦЕНТРАЛЬНОЙ ГЕМОДИНАМИКИ В УСЛОВИЯХ КОМБИНИРОВАННОЙ АНЕСТЕЗИИ СЕВОФЛУРАНОМ ПРИ ХИРУРГИЧЕСКОЙ КОРРЕКЦИИ КАТАРАКТЫ У ДЕТЕЙ

И.А.Маматкулов, Э.А.Сатвалдиева, А.С.Юсупов, Б.Т.Бузруков, М.Г.Толипов

Ташкентского педиатрического медицинского института

Резюме

Цель исследования: Методы совершенствования анестезиологической помощи с применением севофлурана при хирургическом лечении катаракты у детей.

Материалы и методы. Обследовано 54 ребенка вовремя офтальмохирургических операций с применением севофлурана под комбинированной анестезией.

Результаты и обсуждение. Результаты, полученные в результате исследований, основанных на изучении показателей центральной гемодинамики, показали минимальные изменения в ответ на системный ответ гемодинамики, эти изменения были связаны с особенностями фармакологического действия фентанила и севофлурана. Следует отметить, что во время анестезии для этого состояния характерна тенденция к умеренной гиподинамии кровообращения.

Ключевые слова: детская анестезия, ингаляционные анестетики, севофлуран, фентанил, показатели центральной гемодинамики.

БОЛАЛАРДА КАТАРАКТАНИ ХИРУРГИК КОРРЕКЦИЯЛАШДА СЕВОФЛУРАН БИЛАН КОМБИНИРЛАНГАН АНЕСТЕЗИЯ ШАРОИТИДА МАРКАЗИЙ ГЕМОДИНАМИКА МОНИТОРИНГИ

И.А.Маматкулов, Э.А.Сатвалдиева, А.С.Юсупов, Б.Т.Бузруков, М.Г.Толипов

Тошкент педиатрия тиббиёт институти

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Резюме

Тадқиқот мақсади: Болаларда катарактани хирургик даволашда севофлуранни қўллаб анестезиологик таъминотни такомиллаштириш усуллари.

Материал ва услублар: Комбинирланган анестезия асосида севофлуран қўлланилиб офтальмохирургик операцияларда 54 бемор бола текширувдан ўтказилди.

Натижалар ва муҳокама: Тадқиқотлардан олинган маълумотлар марказий гемодинамика кўрсаткичларини ўрганиш асосида олинган натижалар гемодинамиканинг тизимли реакциясига жавобан минимал ўзгаришлар мавжудлигини кўрсатди, бу ўзгаришлар фентанил ҳамда севофлураннинг фармакологик таъсири хусусиятлари билан боғлиқ бўлди. Қайд этиш лозимки, анестезия вақтида ушбу ҳолат қон айланишининг ўртача гиподинамияга мойиллиги билан характерланади.

Калит сўзлар: болалар анестезияси, ингаляцион анестетиклар, севофлуран, фентанил, марказий гемодинамика кўрсаткичлари.

Relevance

Clouding of the lens - cataract in children is one of the leading causes of primary blindness [1]. One of the priority anesthesia drugs in the surgical treatment of cataracts in children, the most widely used in pediatric practice, is the inhalation anesthetic sevoflurane [2,3,5]. The drug, characterized by dose-dependent respiratory depression, with a minimal effect on the cardiovascular system, allows for highly controlled inhalation anesthesia with instant induction and rapid awakening, contributing to the rapid postoperative recovery of the patient's consciousness [4,8]. Sevoflurane has no negative hemodynamic effects, slightly affects intracranial and intraocular pressure [6,9,13]. It is possible to perform anesthesia using low- and minimal-flow techniques, which provide more favorable environmental conditions in the respiratory circuit, which gives a positive economic effect. The use of modern drugs for general anesthesia and these schemes for conducting anesthesia, both during induction and during intraoperative and postoperative management of the patient, made it possible to avoid many negative reactions inherent in other anesthetics, such as ketamine, halothane, sodium thiopental, which can cause hypertensive syndrome , increase intraocular pressure, motor reactions, increase the time of recovery from anesthesia [9,10,11,12].

Thus, general anesthesia with sevoflurane in the surgical treatment of cataracts in children is decisive and optimal.

Purpose: Improving the methods of anesthetic management using sevoflurane in the surgical treatment of cataracts in children.

Material and methods

To provide anesthetic protection in 54 sick children during ophthalmosurgical interventions, the following combinations were used: fentanyl with sevoflurane (Group 1 - 55.6%), fentanyl with propofol (Group 2 - 44.4%).

Children aged 2–4 years accounted for 62.9%, children aged 5–7 years accounted for 37.1% of the total number of patients.

Anesthesia was performed during operations of congenital and traumatic cataracts with the imposition of an IOL (implantation of an artificial lens). The duration of anesthesia in 59.4% of patients was up to 1 hour, in 40.6% - up to 2 hours.

Patients of the 1st group after premedication began inhalation of sevoflurane up to 3 vol%. Fentanyl was administered intravenously at a dose of 3 μg/kg. All patients underwent tracheal intubation against the background of the introduction of arduan at a dose of 0.06 mg/kg. IVL was performed using the Drager Fabius plus device (Germany) along a 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 1.0–2.0 vol%. Infusion therapy was carried out at a rate of 5 - 7 ml/kg/hour. 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.

Patients of the 2nd group received bolus propofol (3 mg/kg) and fentanyl 0.005% (0.03 mg/kg) during the induction period [7,14]. For operations lasting more than one hour, the maintenance of the surgical level of anesthesia was carried out by repeated administration of fentanyl at a dose of 1/2 or 1/3 of the initial dose. The dose of propofol during the period of maintenance of anesthesia, which was administered through the lineomat, averaged 7.3±0.4 mg/kg/h. The duration of the awakening stage was 15.5±5.6 min.

The study of hemodynamics was carried out on the echocardiograph "SonoScape" (China) with a sensor of 3.5 MHz. Echocardiography

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(EchoCG) parameters were calculated automatically. The following values were determined: stroke index (SI) = SVR/S ml/m2, cardiac index (CI) = MOS/S l (min*m2), specific peripheral resistance (SIR) = SBP/SI in conv. 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....

Result and 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 (RPS) by 20.74%. It should be noted that patients of the first group reacted more significantly to induction anesthesia and anesthesia. Even before the start of anesthesia, they had tachycardia on the operating table. This was due to the psycho-emotional stress of patients.

Other indicators changed slightly. After the administration of fentanyl, hemodynamic parameters such as stroke index (SI), mean dynamic pressure (DDP), cardiac index (CI), ejection fraction (FI) and heart rate decreased compared with those of the premedication period, respectively, by 14.21% (P<0.05), 3.98%, 8.57%, 4.19% and 2.79%, excluding HIPS. These significant differences in the response of systemic hemodynamics are associated with the peculiarities of the pharmacological action of both fentanyl and sevoflurane.

It should be noted that this condition characterized the state of moderate circulatory hypodynamia. Sevoflurane mainly affects the tone of the peripheral vascular bed, causing vasoplegia, fentanyl reduces cardiac output, increasing vascular vasoplegia. 10 minutes after intubation, there was a significant increase in SI by 20.44%, SI by 21.65%, and DDS by 8.53%, while at the same time, there was a decrease in UPS by 13.76% (P<0.05).

Table 1. **Hemodynamic parameters during combined anesthesia with the use of fentanyl and sevoflurane (M±m)**

Indicators	Research stages				
	Exodus	Premedication	Introductory period	traumatic ny stage of the operation	End of opera tions
UI, ml/m^2	42,14± 0,99	39,34±1,69	33,75±0,96***	39,22±2,11	41,33 ±1,04
SDD, 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
SI, l/min x m2	4,82±0,41	4,9±0,28	4,48±0,29	4,66±0,26	4,83±0,27
UPS, arb. unit	18,18± 1,57	14,41±1,07	17,0±0,73	17,63±1,44	15,57±1,48
FI, %	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 indicators compared with the initial value (P<0.05). ** - reliability of differences in indicators compared with the previous stage of the study (P<0.05).*

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

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The reasons for the decrease in DDS and SI were the presence of rigidity of the microcirculatory bed, limited cantractile capabilities of the heart muscle. At the end of the operation, there were also minimal changes in indicators.

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), SI by 2.5%, SI by 2.33%, SBP by 0 86%, UPS by 2.74% and FI by 1.11% (P>0.05), associated with emotional discomfort before surgery and the condition of patients after premedication.

Table 2. **Hemodynamic parameters during combined anesthesia with the use of fentanyl in combination with propofol (M±m)**

Indicators	Research stages				
	Exodus	Premedication	Introductory period	traumatic ny stage of the operation	End of opera tions
UI, ml/m2	47,26±1,61	48,44±1,59	46,58±1,3	47,14±1,41	47,38±3,27
SDD, mm. rt. st	119,13±1,82	126,81±2,2*	119,06±2,25**	120,54±2,06	123,94±2,02
SI, l/min x m2	4,73±0,16	4,84±0,16	4,66±0,13	5,61±0,23***	5,97±0,51*
UPS, arb. unit	84,80±1,94	85,53±1,93	79,40±2,00**	82,87±1,71	76,97±1,18***
UPS, arb. unit.	48,29±4,03	50,16±4,39	48,36±3,82	48,13±4,05	52,72±4,13
FI, %	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 to the initial value*
*** - significance of differences at P<0.05 in comparison with the previous stage of the study*

Against the background of induction into anesthesia, a slight decrease in indicators was observed: CI, HR, SI and SBP by 1.44%, 2.42%, 1.48% and 6.37%, respectively. At the same time, the SSA and FI increased slightly - by 0.1% and 0.13%, respectively, which turned out to be statistically unreliable (P>0.05). Compared with the stage of premedication, there was a decrease in heart rate by 12.01%, SBP by 7.17% (P<0.05). Given the hypotensive effect of fentanyl and propofol, the infusion was started without waiting for the fall in blood pressure. This approach made it possible to prevent, and in some cases completely eliminate the critical drop in blood pressure at all stages of anesthesia.

At the end of the operation, hemodynamic parameters remained stable. The changes we found in the studied parameters at the stages of the operation were unreliable, except for the SI 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 an unreliable decrease in IOP by 13.43%, in the 2nd group - 7.44% (Table 3).

Table 3. **Change in IOP during combined anesthesia in children**

№	Type of anesthesia	Before surgery	After operation
1	Fentanyl + sevoflurane	25.7±1.58	21.2±1.25
2	Fentanyl + propofol	24,4±1,22	22,3±1,29

Conclusions

1. The study of the response of the cardiovascular system to combined anesthesia and surgery in children with ophthalmic pathology is accompanied by a slight and compensated change in the main hemodynamic parameters.
2. Anesthesia using fentanyl with sevoflurane and fentanyl with propofol is accompanied by a decrease in IOP, which creates optimal conditions for the surgical treatment of cataracts in children.

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