

CHANGES IN THE LEVEL OF STRESS HORMONES WHILE USING LOW-OPIOID ANESTHESIA IN CHILDREN'S ORTHOPEDICS

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Abstract. *The given article describes the quality of anesthesia through the combined use of small doses of the opioid fentanyl during orthopedic operations in children. The study was conducted in 52 patients hospitalized for pectus excavatum, congenital or pathological hip dislocation. The patients were divided into 2 groups: 1 group, which received anesthesia using fentanyl, propofol and sevoflurane; Group 2 anesthesia method with fentanyl and propofol. We studied heart rate (HR), mean dynamic pressure (MDP), levels of cortisol, triiodothyronine (T3), thyroxine (T4).*

Keywords: *opioids, orthopedic surgeries, fentanyl, propofol, sevoflurane.*

It is important to suggest that surgical interventions performed in pediatric orthopedics are multi-staged, highly traumatic and cause significant blood loss. At the same time, methods of general anesthesia must meet the requirements of reliability, low invasiveness, create adequate conditions for the work of the operating team and provide effective, safe pain relief [9]. From this position, opioid analgesics are widely used, which for a long time have been the leading drugs in many surgical interventions, as the “gold standard” [6].

However, excessive use of opioids is accompanied by the development of a number of negative effects and complications [1]. Inappropriate intraoperative analgesia causes chronic postoperative pain and complications. This, in turn, affects the patient’s length of stay in the hospital and the funds spent on treatment [4,7].

Two drugs have become the mainstay of general anesthesia in recent decades: the opioid analgesic fentanyl and sevoflurane. The former has become a core component of many combined general anesthesia protocols [2], the latter, sevoflurane, is used to maintain and even induce general anesthesia [10]. But they can cause opioid-induced hyperalgesia during the post-administration phase. Numerous scientific studies have shown that the more opioid administered during surgery, the more intense the postoperative secondary hyperalgesia [8].

These observations have prompted the development of opioid-sparing technologies, a combination of opioid and non-opioid analgesics that promote early rehabilitation of patients and reduce treatment costs. Concurrently, interest for perioperative non-opioid adjuvant drugs such as dexamethasone among others has increased, with reports of beneficial analgesic and antihyperalgesic properties extending into the postoperative period. The administration of dexamethasone before surgery is more effective than its intraoperative administration [3]. Dexamethasone affects the intensity of pain after surgery, reducing it, as well as the need for analgesics.

Definitely, the final choice of the opioid analgesic fentanyl and adequate combinations when performing general anesthesia during orthopedic operations in children is the most relevant.

The purpose of the work is to improve the quality of anesthesia through the combined use of small doses of the opioid fentanyl during orthopedic operations in children.

Materials and methods. The study was conducted in 52 children (3-12 years old) hospitalized at the TashPMI clinic for surgical treatment of pectus excavatum deformity of 2 and 3 degrees, congenital or pathological dislocation of the hip. The objective status of the patients according to ASA corresponded to class II-III.

Criteria for inclusion in the study group:

- age from 3 to 12 years;
- informed consent of parents for surgical intervention;

Exclusion criteria for the study group:

- age of patients under 3 years and over 12 years;
- patients with stage 4 funnel chest with breathing problems;
- patients with keeled chest deformity.

According to the plan of the studies and according to the method of anesthesia, patients were divided into 2 groups: group 1 consisted of 27 (52%) who were anesthetized using fentanyl, propofol and sevoflurane; Group 2 25 (48%) who used the anesthesia method with fentanyl and propofol (see table).

Distribution of examined children by gender

Indicators		Group 1		Group 2	
		abs	%	abs	%
Number of patients (n)		27	52±5,0	25	48±5,0
Average age of patients in years (Me) (%)		6,8±0,60		6,8±0,47	
G Gender	Girls	12	44,4±7,4	11	44±6,7
	Boys	15	55,5±7,4	14	56±6,7
Duration of operation		72,0±3,2		81,2±4,6	
Duration of anesthesia		89,8±3,1		101,7±4,9	

All patients received standard premedication and combined general anesthesia based on fentanyl was used for anesthetic management of the surgical intervention. Patients of the first group were administered dexamethasone 0.4% - 0.15 mg/kg 40 minutes before surgery. For induction of anesthesia, propofol 2 mg/kg, fentanyl 0.005% 3-2.5 µg/kg, and Arduan 0.2%-0.06 mg/kg were sequentially administered intravenously. Maintaining general anesthesia: insufflation of sevoflurane at a dose of 3 vol. % followed by a decrease to 1.5 vol. %, fentanyl 1/2 and 1/3 of the induction dose.

In the second group, induction was carried out by administering propofol 3 mg/kg and fentanyl 5 µg/kg, Arduan 0.06 mg/kg. Maintain anesthesia with propofol 100-150 mcg/kg/min as a continuous infusion of fentanyl 1/2 and 1/3 of the induction dose. At five stages: before surgery, premedication, induction, traumatic moment of surgery and after surgery, heart rate (HR), mean dynamic pressure (MDP) were studied, and the levels of cortisol, triiodothyronine (T3) and thyroxine (T4) were also studied.

Results and discussion. The analysis of heart rate in children of group 1 at the stages of anesthesia and surgery; at the stage of premedication, a significant increase was noted (by 12.9%

from the original), which was considered as a slight increase that did not require correction. Already at the stage of induction into anesthesia, a more significant increase was observed (by 15% from the initial level). The main stage of the operation, as the most painful, was characterized by a tendency to decrease heart rate (by 8% from the initial one), while at the same time remaining within the limits of average physiological norms. The final stage of anesthesia was considered quite distinctive, when the heart rate was slightly reduced (by 9.1% from the initial one), but in most cases did not require deepening of anesthesia.

Thus, it can be noted that the heart rate indicator at almost all stages of surgical treatment of orthopedic pathologies in children was evenly distributed within the limits of average physiological parameters.

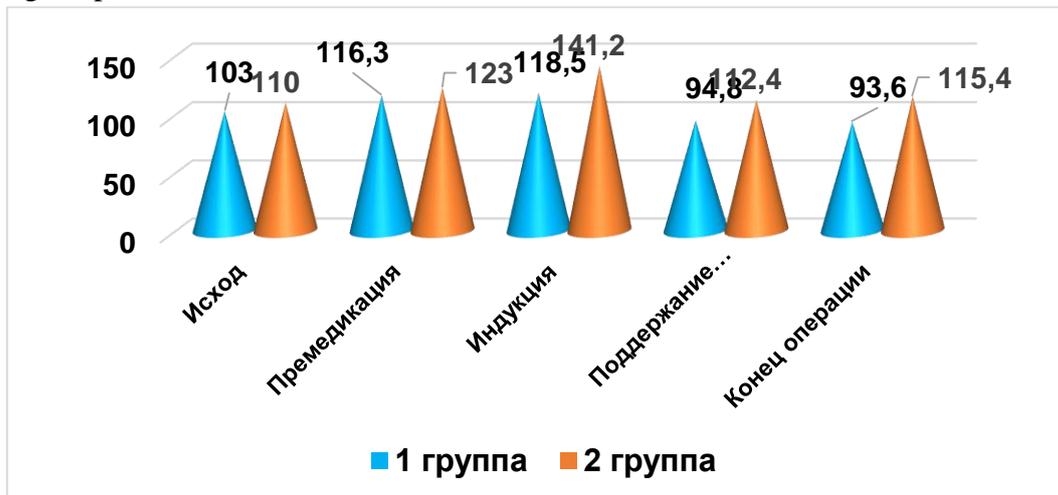


Fig 1. Dynamics of heart rate at different stages of the study

Another representative in the group of hemodynamic indicators was the level of MAP, which characterizes the total difference between systolic and diastolic blood pressure. In patients of group 1 at the stage of premedication, the parameters of the SDD were relatively reduced (by 1.3% from the initial level), which did not require correction. A uniform decrease in MDD at the main stage of maintaining anesthesia (by 11.4% from the initial one) did not change the general condition of the patients and was considered as average physiological. Upon completion of all stages of surgical treatment and methods of anesthesia, only a slight decrease in MDD was noted relative to the previous stage. It can be noted that changes in SDD during all stages of anesthesia did not undergo significant changes, which characterizes the positively applied method of general anesthesia.

A fairly thorough study of hemodynamic parameters was also carried out in patients of group 2. Considering the obtained information on heart rate indicators at the stages of anesthesia, one can note a fairly pronounced difference in the fluctuations of the n indicator in the prism of comparing a similar parameter in group 1. The premedication stage was characterized by a similar increase in heart rate relative to the initial values by 11.74%. The most significant changes occurred at the stage of induction into anesthesia, when a special increase in heart rate was recorded (by 28.16% from the initial one), which required corrective intervention with drugs and leveling out the administration of anesthetics. This, in turn, made it possible to achieve a fairly striking reduction in the indicator at the main stage of anesthesia. Already at the stage of completion of the surgical intervention and anesthetic management methods, an objective increase in the heart rate level was registered, slightly increased by 4.86% from the initial one. I would like

to note that this type of pain relief requires a special approach and vigilance during orthopedic operations, regulation of the hemodynamic capabilities of the body.

The level of DDS in group 1 patients was slightly lower than in group 2, however, the variations in changes at the stages of anesthesia were relatively uniform than in patients in group 2.

The considered heart rate parameter in patients in group 2 was significantly higher than in patients in group 1 (by 10.87%), with a certain decrease at the main stage (16.91%), to 18.54% at the final stage. This is a rather distinctive feature of the proposed scheme of anesthesia for patients during orthopedic operations.

Considering cortisol indicators in a comparative aspect between the two groups, we can note higher values in patients of group 2 (Fig. 2).



Fig. 2. Dynamics of cortisol indicator at the stages of the study

Already at the initial level, an increase in the level of this parameter was noted in children in group 2 with a difference of 17.77% ($P>0.05$) in relation to the data in group 1, with a certain increase as at the main stage of surgical intervention - by 19.63% ($P>0.01$), and at the final stage - by 18.73% ($P>0.01$), respectively.

Fluctuations in T3 levels in both groups were insignificant at the stages of the operation, however, in group 2, higher parameters were noted in relation to similar indicators in group 1. Thus, already at the initial stage, the results obtained indicated higher values of this parameter by 10.9% ($P>0.01$) in group 2 of patients.

A certain increase in the controlled indicator was noted at the main stage of anesthesia, when the level of T3 in group 2 of patients was 8.93% ($P>0.01$) higher than in group 1, and at the end of anesthesia - by 8.7% ($P>0.01$) from similar indicators in group 1 (Fig. 3).

Studies have revealed an increase in T4 levels in patients of group 2 at all stages of anesthesia. Thus, the initial level of this parameter was 11.4% ($P>0.05$), higher than in group 1 with a sufficient increase at the main stage of the operation - by 22.87% ($P<0.05$). Its decrease at the stage of completion of anesthesia was insignificant - by 16.55% ($P>0.001$) in group 2, from the indicator in group 1 (Fig. 4).



Fig.3. Changes in T3 indicator at different stages of the study

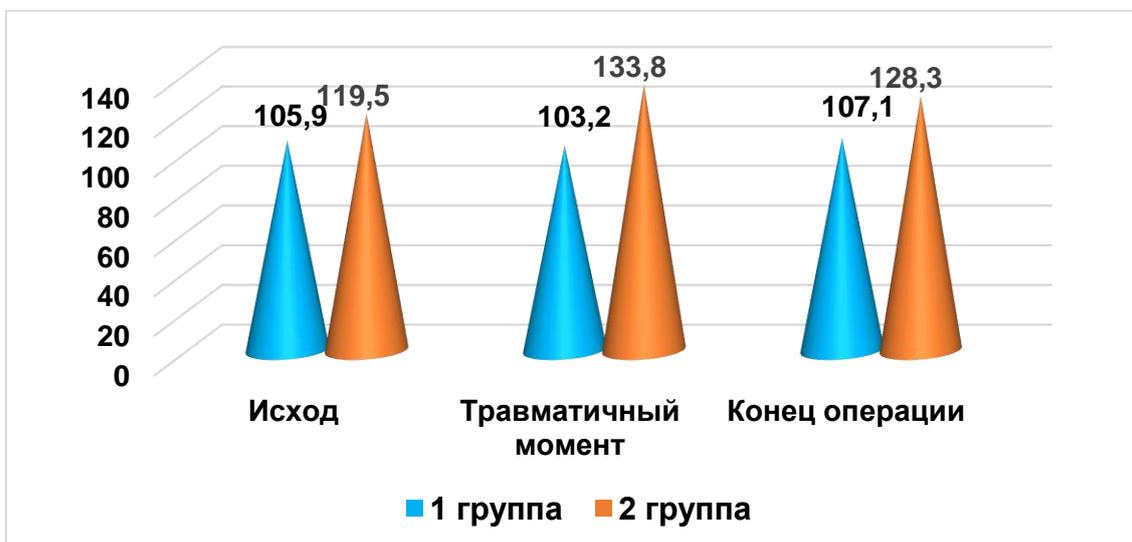


Fig.4. Dynamics of T4 indicator at different stages of the study

Thus, it can be noted that when performing standard anesthesia with fentanyl and propofol in children during orthopedic operations, the T4 level tends to increase already at the initial stage, with a further tendency towards the final stage.

At the same time, indicators of hormonal status in the perioperative period in patients of group 2 were significantly increased compared to similar indicators in group 1. When assessing the levels of cortisol, T3, T4, a fairly significant increase in their values was observed in patients in group 2.

Thus, based on the studies conducted, we can conclude that the implementation of the proposed anesthesia technique in patients of group 1 is significantly more effective and efficient than standard anesthesia.

Conclusion.

1. Combined general anesthesia based on small doses of fentanyl, sevoflurane and propofol is characterized by a smooth clinical course and maintaining the stability of systemic hemodynamics in children during orthopedic operations.

2. A moderate increase in triiodothyronine (T3) with suppression of cortisol release at the stage of the traumatic moment of the operation confirms sufficient anti-stress protection under conditions of general anesthesia with sevoflurane, fentanyl and propofol.

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