
# Study the State of Hemodynamics and Ophthalmotonus When Using Propofol and Fentanyl in Ophthalmic Surgery

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ABSTRACT

Anesthesia in ophthalmology is an urgent problem of modern medicine, which is due to the specifics of intraocular operations. This is, first of all, a state of ophthalmotonus, which is influenced by both local and general anesthesia. If the volume of blood inside the eye increases, the intraocular pressure (IOP) also increases. An increase in venous pressure leads to an increase in IOP due to a decrease in the outflow of aqueous humor and an increase in blood volume in the choroid. Fluctuations in CVP, BP, PaCO2 and PaO2 affect IOP.

**Keywords:** Propofol, fentanyl, IOP, ADsyst, ADdias, SAD

## Research Aim

The aim of the research is to examine the state of peripheral and central hemodynamics and ocular tonus during the use of propofol with fentanyl in ophthalmic surgery in patients with acquired cataracts.

## Materials and Methods of the Research

The research was conducted at a multidisciplinary clinic of the Tashkent Medical Academy. 42 (42 eyes) patients of both sexes aged 60-80 years with concomitant cardiovascular disease were examined (mean age 68.2 ±3.2 years). The patients underwent extracapsular cataract extraction with intraocular lens implantation.

In addition to routine clinical and biochemical examinations, we used a multifunctional "reanimation-surgical" monitor YUM 300 (LLC "Company YUTAS" Ukraine) to assess the effectiveness of anesthesia and in the perioperative period. This device is designed for continuous monitoring of the patient's vital functions, displaying them on the screen, and signaling deviations in the controlled parameters. (see figure 1)

**Fig.1. Polyfunctional "reanimation-surgical" monitor YM 300.**

In our research, we used the following capabilities of the monitor:
1. Registration and monitoring of ECG;
2. Measurement (monitoring) of heart rate with the possibility of selecting a source (ECG, SpO2);
3. Registration and automatic recording of arrhythmias;
4. Measurement (monitoring) of capillary blood oxygen saturation (pulse oximetry);
5. Non-invasive continuous monitoring of central hemodynamics parameters using impedance cardiography (ICU module): UI, CI, HR;
6. We also studied the following indicators of peripheral hemodynamics: systolic (SBP), diastolic (DBP), pulse (PP) pressure, mean arterial pressure (MAP), and blood flow velocity (BFV) by the MacLachlan method.

Statistical analysis was conducted using Microsoft Excel and SPSS 25000 (JBM) software. Data with a normal distribution (after checking with the Kolmogorov-Smirnov test and evaluating equality of variances with the Levene's test) were presented as means (M) with standard deviations and evaluated using the Student's t-test. Non-parametric data were evaluated using the Mann-Whitney test. Fisher's criteria were applied to determine the statistical significance of differences in nominal data. Differences were considered significant at $p < 0.05$.

## Research Results and Their Discussions

Anesthesia for patients in this group was conducted using propofol and fentanyl. All patients received standard premedication: sedatives the night before the surgery and seduxen 10 mg + non-narcotic analgesics + atropine in appropriate doses 30 minutes before the operation. For premedication, non-narcotic analgesics such as 25-50% analgin 2-4 ml were used. Induction was carried out by sequential intravenous infusion of propofol from 4 to 12 mg/kg/h (on average, it was 6.5+0.2 mg/kg/h), and fentanyl (0.05 mcg). For anesthesia maintenance, propofol was administered by infusion at a rate of 1.5 to 2.5 mg/kg (on average, 2.1+/-0.4 mg/kg). Fentanyl was administered intravenously in bolus doses of 0.05 mg every 15-20 minutes.

**Table №1**
**Peripheral hemodynamics and ophthalmotonus during the use of propofol and fentanyl (n=42)**

| Parameters measured | Unit of measurement | Before anesthesia | After induction | During operation | After operation |
|---|---|---|---|---|---|
| SBP | mmHg | 22,06±0,77 | 19,3±0,63* | - | - |
| DBP | mmHg | 135,6±4,3 | 125,1±4,1 | 120,1±3,5 | 127,1±4,3 |

| | | | | | |
|---|---|---|---|---|---|
| MBP | mmHg | 90,4±2,8 | 69,3±2,5*** | 67,8±3,0^ | 80,5±2,8*^ |
| PP | mmHg | 45,2±1,5 | 47,4±1,5 | 55,8±1,8*** | 47,2±1,6^^ |
| MAP | mmHg | 105,4±3,2 | 98,9±3,7 | 87,9±3,0*** | 96,2±3,3*^ |
| SpO2 | % | 94,4±0,75 | 93,4±0,78 | 94,3±0,68 | 95,3±0,46 |

Note: *-reliably compared to the indicators before anesthesia (*-P<0.05; ***-P<0.001)
^-reliably compared to the indicators during the operation (^-P<0.05; ^^-P<0.01)

The use of propofol was accompanied by a decrease in peripheral vascular resistance, as evidenced indirectly by a decrease in diastolic and systolic blood pressures by 23.3% and 7.7% respectively, and an increase in pulse pressure by 23.4%. It was also noted that the mean dynamic pressure decreased by 16.6%, approaching normal values.

After the operation, most of the changes observed in the second stage of the study returned to their initial values: systolic and diastolic blood pressure increased by 2.1% and 16.1% respectively, and mean arterial pressure increased by 9.4%. The intraocular pressure, which was measured after the operation, decreased by 1.5%.

A certain interest in the use of different anesthesia methods may be represented for ophthalmic surgeons by the state of intraocular pressure. In the group of patients who received ketamine, it significantly increased after induction of anesthesia, while the use of propofol showed the opposite trend. This is explained by the action of propofol on the cardiovascular system, which significantly reduces peripheral vascular resistance, myocardial contractility, and pre-load, leading to a significant reduction in blood pressure. Arterial hypotension is aggravated by the use of large doses of propofol, overly rapid administration, and the patient's old age.

**Central hemodynamics state when using propofol and fentanyl (n=42)**

After induction anesthesia, the following changes were noted in the central hemodynamics. Heart rate decreased by 4.7% compared to the initial value. Stroke index decreased by 7.9%. Consequently, cardiac index decreased by 16.0%, since minute cardiac output is directly proportional to cardiac output and heart rate. The integral tonicity coefficient decreased by 2.1%, which indirectly suggests an improvement in microcirculation. No significant changes in central hemodynamics were observed during stage III of the study. By the end of the operation, heart rate and stroke index increased by 1.7% and 1.3% respectively. Minute cardiac output and arteriolar tone increased by 4.5% and 1.7% respectively.

**Table №2**
**State of central hemodynamics when using propofol and fentanyl (n=42)**

| Measured Indicators | Normal Values | Research Stages | | | |
|---|---|---|---|---|---|
| | | Stage I | Stage II | Stage III | Stage IV |
| | | Before anesthesia | After induction of anesthesia | During surgery | After surgery |
| Heart rate, beats per minute | 60-80 | 79,7±2,7 | 75,9±2,5 | 76,1±2,7 | 77,4±2,8 |
| Stroke volume, ml/m2 | 42-47 | 31,4±1,1 | 28,4±0,93* | 29,5±0,99 | 29,9±1,1 |
| Cardiac index, L/min/m2 | 3,1 | 2,5±0,08 | 2,1±0,07** | 2,2±0,08* | 2,3±0,09 |
| Respiratory rate, breaths | 16-20 | 20,0±0,78 | 19,0±0,70 | 18,0±0,64 | 18,0±0,78 |

| | | | | | |
|---|---|---|---|---|---|
| per minute | | | | | |

Note: * - reliable compared to indicators before anesthesia (* - P <0.05; ** - P <0.01)

The use of propofol in combination with fentanyl was accompanied by a decrease in peripheral vascular resistance, a decrease in heart rate, and indicated a stable course of anesthesia.

## Conclusions

Although the use of propofol is accompanied by a decrease in systemic arterial pressure and peripheral vascular resistance from baseline values, it does not have a negative effect on hemodynamics. The decrease in intraocular pressure helps to create optimal conditions for surgery. It is important to note that only the use of propofol leads to a decrease in intraocular pressure and allows for its regulation, which is particularly important in ophthalmic surgery. All of this makes anesthesia based on propofol the preferred choice for elderly patients undergoing ophthalmic surgery.

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