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STUDY OF THE INFLUENCE OF APPLIED VARIOUS LOCAL ANESTHETICS ON THE STATE OF EYE MICROCIRCULATION DURING OPHTHALMOLOGICAL SURGERY

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Relevance. Anesthetic manual in ophthalmology is an urgent problem of modern medicine, which is due to the specifics of intraocular operations.

The relevance of anesthetic aid in ophthalmology is also increasing due to the fact that more than half of patients undergoing surgical interventions are elderly and senile patients [2,5,8,] with one or more somatic concomitant diseases [4,7,12,17,], which requires a special approach to these patients in terms of preparation for surgery, the choice of anesthesia and postoperative management.

Hemodynamic disorders are one of the important links in the pathogenesis of eye diseases [10, 18]. When providing anesthesia in surgical ophthalmology, it is of great importance to take into account the state of ophthalmotonus, which is directly dependent on the hemodynamics of the eye. The works of many authors [1,7,9,11,10,] indicate that the vascular factor is one of the most important links in the mechanism of changes in intraocular pressure (IOP).

Purpose of the study: To study the effect of the most frequently used anesthetics in retrobulbar blockade on the state of microcirculation of the eyes during ophthalmic operations.

Material and methods. The studies were carried out in 115 operated patients with a diagnosis of acquired cataract. Patients underwent cataract extraction, extracapsular cataract extraction with intraocular lens implantation (EEC with IOL) and tunnel cataract extraction with intraocular lens implantation (EEC with IOL).

The age of patients in the studied groups ranged from 50 to 86 years. More than half (84 patients - 79.2%) of them were aged 60 to 80 years. The average age was 69.6 + 5.3 years.

In the allocation of the patients on the floor of the 115 female patients was 70 (62.3%) and male patients - 45 (37.7%).

To study intraocular hemodynamics, Doppler ultrasound was used, which were performed them.

Ultrasonic scanning was carried out on an ultrasonic Doppler by the company "Kransbuhler" at a radiation frequency of 4 and 8 MHz in a continuous mode.

Many authors [13,14,15,17,19] note the relationship of hemodynamics in the orbital artery with IOP and hydrodynamics. In this regard, we present in this chapter an analysis of the results of regional hemodynamics in the studied groups of patients, since a detailed study of the hemodynamics of the eye is one of the objective parameters of the microvasculature. All patients underwent a Doppler study before and after anesthesia.

The technique was used to visualize blood flow in the central retinal artery (CRA).

Quantitative analysis evaluated the following hemodynamic parameters in the central retinal artery (CRA):

1. Vs - maximum systolic blood flow velocity, cm / s;
2.Vd - end diastolic velocity, reflects the elastic-elastic properties of the artery, cm / s;
3.Ri - index of circulatory resistance or index of resistance (Purselo index), reflecting an increase in the resistance of blood flow in the vessels.

Research results and their discussion. We examined 115 patients, 87 patients had concomitant diseases. It should be noted that the majority (81 patients) had 2 or more concomitant diseases. The incidence of coronary heart disease (IHD) and hypertension (HD) prevailed over the rest of the comorbidities (chronic pyelonephritis, chronic bronchitis, gastric ulcer, chronic hepatitis, diabetes mellitus, consequences of acute cerebrovascular accident.

All patients underwent clinical examination before admission to the clinic.

The patients were divided into three groups depending on the applied local anesthetic for retrobulbar blockade. Group I consisted of patients who received 2-4% novocaine as a local anesthetic, group II used 2-4% lidocaine solution, and group III used 0.5% bupivacaine solution for conduction anesthesia.

With the aim of comparability of the compared groups, we deliberately formed the groups in such a way that they were representative in all parameters.

Regional blockade in all studied groups was performed according to the technique proposed by J. Morgan, S. Michael (1998) [6]. The solution volume and concentration depended on the anatomical features of the eyeball and the surgical intervention performed. So in patients with endophthalmos for "removal" of the eyeball, creating favorable conditions for the surgeon, injected for retrobulbar anesthesia was in the range from 5 to 10 ml. And for patients with bulging of the eyeball and a smaller orbital volume - from 3 to 5 ml. The average volume of the solution was 7.2 + 0.4 ml.

We performed a facial nerve block according to van Lint. A 25G needle with a blunt end was used. An injection was made into the lower eyelid at the border of the middle and lateral third of the orbit (usually 0.5 cm medial to the lateral angle of the palpebral fissure). The patient was asked to look up, above the tip of the nose, the needle was advanced 3.5 cm towards the apex of the muscle cone. After excluding the intravascular position of the needle using an aspiration test, a local anesthetic was injected, after which the needle was removed. Retrobulbar blockade provided anesthesia, akinesia (immobility of the eyeball) and eliminated the oculocephalic reflex.

For premedication, non-narcotic analgesics, antihistamines, and atropine were used. However, when using the last and its dose, the intraocular pressure indicators were taken into account.

When performing sedation, we were aware of the fact that more important is not which drug is used, but its dose, since deep sedation is contraindicated in ophthalmic surgery, since it increases the risk of apnea and involuntary movements of the patient during surgery. On the other hand, superficial sedation does not prevent discomfort when performing retrobulbar block. For sedation, we used propofol in all cases. Depending on age and concomitant pathology, this drug was used at a dose of 0.8 + 0.3 mg / kg with a range of 0.3 to 1.2 mg / kg, which was administered intravenously in a bolus over 1-5 minutes. Further, the required depth of sedation was adjusted by drip intravenous administration of this drug in doses from 1.5 to 4.5 mg / kg / h (on average 2.9 + 0.2 mg / kg / h). For a quick deepening of sedation, an additional bolus of 10-20 mg of propofol was administered.

Regardless of the sedation method, continuous monitoring of respiration and oxygenation (pulse oximetry), blood pressure (BP) and heart rate (HR) were performed. And for patients with concomitant pathology of the cardiovascular system (CVS) - ECG monitoring.

The qualitative and quantitative assessment of anesthesia of the eye under the influence of local anesthetics was carried out according to changes in intraocular hemodynamics. The activity of local anesthetics during regional anesthesia of the eyeball was assessed by the presence of ptosis and the absence of eyeball movement in all directions.

I. The state of the CRA in Doppler ultrasound in patients of group I.

Doppler ultrasound was performed in all patients of group I before and after the conduction block. Hemodynamic changes before and after anesthesia are given in Table 1. The initial data of the Doppler study of our patients, as can be seen from the table, slightly differed from the normal values. Systolic and diastolic blood flow was lower than normal by 19.3% and 7.3%, respectively. The increased resistance of blood flow in the vessels is evidenced by an increase in the index of resistance from physiological values by 0.1 (14.2%). After the blockade with novocaine, some improvement in blood flow and a decrease in circulatory resistance were noted, which was expressed in an increase in Vmax and Vmin by 0.4 cm / s (3.5%) and 0.3 cm / s (7.9%).

Table 1: Quantitative indicators of hemodynamic changes in the CRA with novocaine anesthesia (n = 32)

Hemodynamic indicators	Norm	baseline data (before anesthesia)	after anesthesia
Vmax, cm / s	14,0±0,75	11,3±0,51*	11,7±0,56*
Vmin, cm / s	4,1±0,24	3,8±0,20	4,1±0,23
Ri	0,70±0,04	0,80±0,05	0,62±0,03^

Note: * - reliable compared with the indicators of normal values (* -P <0.05)
^ - reliable in comparison with the initial data (^ -P <0.05)

Progressive changes in the hemodynamics of the CRA caused by the effect of the retrobulbar novocaine block allowed us to conclude that the initial decrease in blood flow in the central retinal artery is not so much associated with organic changes depending on the age of our patients, as with the very pathology of the eyes with a predominance of the spastic component.

After the blockade, in addition to anesthesia, it is necessary to note some positive changes in the microcirculation of the eyes, which are manifested in an improvement in blood flow and a decrease in the resistance of the retinal artery vessels. Naturally, all this has a positive effect on intraocular pressure, surgical tactics and outcome.

II. The state of the CRA in Doppler ultrasound in patients of group II.

The initial data of the Doppler study of microcirculation in the group of patients who received anesthesia with lidocaine (see Table No. 2) were similar to the previous group of patients: Vmax and Vmin were underestimated from normal values by 3.1 cm / s (22.1%), respectively, and 0.2 cm / s (4.9%). Similar changes were noted on the Ri side - an increase of 0.1 (14.2%). The data is shown in the following table.

Table 2: Quantitative indicators of hemodynamic changes in the CRA during anesthesia with lidocaine (n = 38)

Hemodynamic indicators	Norm	baseline data (before anesthesia)	after anesthesia
Vmax, cm / s	14,0±0,75	10,9±0,46**	12,4±0,52*,^
Vmin, cm / s	4,1±0,24	3,9±0,21	4,3±0,25
Ri	0,7±0,04	0,81±0,04*	0,50±0,02***,^^^

Note: * -reliable compared with the indicators of normal values (* -P <0.05; ** - P <0.01; *** - P <0.001)

^ - reliable in comparison with the initial data (^ -P <0.05; ^^^ - P <0.001)

Following retrobulbar anesthesia and facial nerve anesthesia, the following changes occurred. An increase in systolic and diastolic blood flow velocity by 1.5 cm / s (13.8%) and 0.4 cm / s (10.2%), respectively, indicates an improvement in blood circulation at the level of the microvasculature of the CRA. A decrease in the resistance index by 0.3 or 37.5% indicates vasodilation of resistive vessels.

III. The state of the CRA in Doppler ultrasound in patients of group III

The studies of the initial data of the III group of patients revealed significant changes in the CRA (see table. No. 3). The difference between the initial Vmax data and the normal values was 3.0 cm / s (21.4%). End-diastolic blood flow velocity was within the normal range. An increase in Ri by 28.6% indicated a pronounced spastic component.

Table 3: Quantitative indicators of hemodynamic changes in the CAC during bupivacaine anesthesia (n = 45)

Hemodynamic indicators	Norm	baseline data (before anesthesia)	after anesthesia
Vmax, cm / s	14,0±0,75	11,0±0,51**	12,7±0,58^
Vmin, cm / s	4,1±0,24	4,1±0,22	6,6±0,32***,^^^
Ri	0,7±0,04	0,89±0,05**	0,51±0,03**,^^^

Note: * -reliable compared with the indicators of normal values (** - P <0.01; *** - P <0.001)

^ - reliable in comparison with the initial data (^ -P <0.05; ^^^ - P <0.001)

In the examined patients, after bupivacaine anesthesia, an improvement in blood flow velocity and a decrease in vascular tone were revealed: systolic, diastolic blood flow increased by 1.7 cm / s and 2.5 cm / s, or 15.4% and 60.9%, respectively; a decrease in Ri by 0.4 or 55.5% indicated a decrease in the tone of resistive vessels - arterioles.

IV. Comparative characteristics of the state of the CRA in the studied patients

In order to comparatively study the effect of individual local anesthetics on the hemodynamic parameters of the CRA, we compared the studied data by groups (see Table No. 4). If the systolic blood flow velocity in group I before and after anesthesia with novocaine increases by 3.5%; then in groups II and III, where anesthesia was performed with lidocaine and bupivicaine, this figure is 13.8% and 15.4%. Also, the increase in end-diastolic velocity in the CAC, if compared by groups, before and after the blockade at the research stages, respectively, was 7.9%; 10.2% and 60.9%. When comparing changes in the circulatory resistance index in the studied groups, the following was noted: in group I, the decrease in the tone of resistive vessels after anesthesia was 25%, in groups II and III - 37.5% and 55.5%, respectively.

Table 4: Indicators of hemodynamics of the CRA of the studied groups

Study groups		Hemodynamic indicators Vmin, cm / s Ri		
		Vmax, cm / s	Vmin, cm / s	Ri
Group I (n=32)	before anesthesia	11,3±0,51*	3,8±0,20	0,80±0,05
	after anesthesia	11,7±0,56*	4,1±0,23	0,62±0,03^
Group II (n=38)	before anesthesia	10,9±0,46**	3,9±0,21	0,81±0,04*
	after anesthesia	12,4±0,52*,^	4,3±0,25	0,50±0,02***,^^^
Group III (n=45)	before anesthesia	11,0±0,51**	4,1±0,22	0,89±0,05**
	after anesthesia	12,7±0,58^	6,6±0,32***,^^^	0,51±0,03**,^^^
Norm		14,0±0,75	4,1±0,24	0,7±0,04

Note: * -reliable compared with the indicators of normal values (* -P <0.05; ** - P <0.01; *** - P <0.001)

^ - reliable in comparison with the initial data (^ -P <0.05; ^^^ - P <0.001)

From the table presented, unidirectional changes in the hemodynamics of the CAS caused by the local anesthetics we used are clearly visible, but the severity of these changes and their points of application are somewhat different. When comparing the changes in the initial values of Vmax, Vmin and Ri in patients in all three groups with normal values of the same indicators, all of them were statistically significantly (P <0.05) lower, which we explained by age characteristics and the presence of ophthalmic pathology.

However, the effects of each of the applied local anesthetics on the studied parameters of the CAC hemodynamics differed in their severity. So, if the systolic and diastolic blood flow velocity in patients of group I after novocaine blockade only outlined a tendency to increase (P> 0.05), then the decrease in the tone of resistive microcirculation vessels was statistically significant (P <0.05) by 29%. Lidocaine led to slightly more pronounced changes in the studied parameters of the hemodynamics of the CAC relative to novocaine. Vmax and Vmin in patients of group II, having increased after blockade by 13.8 and 10.2%, respectively, exceeded the same indicators in group I patients by 10.3% (P <0.05) and 2.3% (P> 0.05). Statistically significant (P <0.05) lidocaine decreased the tone of the retinal resistive vessels more than novocaine.

The greatest improvement in blood flow velocity and Vmax and Vmin with retrobulbar blockade with bupivacaine, which was 11.9% (P <0.05) and 53% (P <0.02) higher than the same indicators in group I patients, respectively, and by 1, 6% (P> 0.05) and 50.7% (P <0.05) in group II patients. As for the state of the tone of the resistive vessels of the retina, bupivacaine, reducing it by 55.5% relative to the initial values, had a more pronounced effect in comparison with groups I and II by 33% (P <0.05) and 18% (P < 0.05), respectively.

Conclusions

Thus, according to their power, the anesthetics studied by us can be distributed in the following order: novocaine - lidocaine - bupivacaine. It is known that the power of the anesthetic depends on the solubility in fats: the higher the solubility of the anesthetic in fats, the more pronounced the effect. Moreover, if the solubility of novocaine in fats is <1, then for lidocaine and bupivacaine this figure is 4 and 28, respectively (16). The greatest improvement in blood flow rate with retrobulbar blockade with bupivacaine, in relation to the use of novocaine and lidocaine.

For surgical operations requiring deep long-term anesthesia, 0.5% bupivacaine, a drug with pronounced anesthetic properties, can be used. It should also be noted that the blood flow velocity improved to the greatest extent during retrobulbar blockade with bupivacaine, which exceeded the same indicators in patients of groups I and II, which was proved by ultrasound dopplerography of the CRA.

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