

Features of the Action of Local Anesthetics on in-Eye Pressure and Ocular Hydrodynamics.

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Abstract--72 patients were surveyed (72 eyes) diagnosed with cataracts (acquired) and glaucoma, operated under local anesthesia. All patients used retrobulbar blocking and blocking of the facial nerve. We studied the analgesic action of different local anesthetics in ophthalmic surgery and their influence on intraocular pressure, producing intraocular hydrodynamics and relaxation of the eye muscles. As a local anesthetic we used 2% lidocaine, 0.5% bupivacaine and 0.5% longocaine solution. The study showed that when retrobulbar injection the total duration of anaesthesia of the eyeball under the effect of bupivacaine and longocaine (0.5%) in average was 3 times longer than when applying 2% lidocaine. Bupivacaine (0.5%) and longocaine (0.5%) used for anesthesia caused a good relaxation and resulted in a significant reduction of intraocular pressure by lowering aqueous humor secretion, improving the coefficient of aqueous humor outflow, which helps to prevent complications from the eye during surgery and in the postoperative period. Lidocaine (2%) in retrobulbar injection causes a full anesthesia of eyeball with a short duration of action. The drug does not cause proper myoplegia and its hypotensive effect is negligible.

Keywords--lidocaine, bupivacaine, longocaine, cataract, glaucoma, retrobulbar blocking

I. INTRODUCTION

Progress of surgery of cataract and glaucoma are used to apply local anaesthesia of the eyeball as a stand-alone method of anesthesia or in combination with sedatives (2,7). A large number of abdominal operations existing in ophthalmology, in which local anaesthetics applied during the intervention with a view to eliminate pain gave new impetus to the study of the efficacy and duration of retrobulbar anesthesia, and its effect on intraocular pressure (IOP) (6, 7, 9, 12).

Regional anesthesia may have the most complete analgesic effect due to suppression of nociceptive impulses and create autonomic blocking. The main criterion for selecting drugs for local anesthesia in operative ophthalmology is rapid onset of anesthetic effect, myoplegia and lowering IOP.

Requirements for local anesthetics in ophthalmology are various. Higher concentrations of drugs are required for anesthesia during eye surgery that cause long lasting and profound loss of tissues sensitivity of the eyeball. For pain control after abdominal operations (antiglaucomatous, extracapsular extraction of cataract with

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implantation of intraocular lenses) just use the minimum concentration of anesthetic, that do not imply toxic effects on the corneal epithelium and cause a shallow, superficial anesthesia (11, 12).

However, so far the activity of different drugs in surface anaesthesia of the eyeball has not been thoroughly researched. Data available in accessible literature data are contradictory, due to use of different research methods. Currently, the most widely used are: 2-4% lidocaine (xylocaine, Astra, Sweden). 0.5 -0.75% bupivacaine (marcaine, Astra, Sweden). Longocaine (bupivacaine hydrochloride, Yuria pharm, Ukraine).

The purpose of the study is a comparative study of the analgesic action of different local anesthetics in ophthalmic surgery and their influence on intraocular pressure, producing intraocular dynamics and relaxation of the eye muscles.

II. MATERIALS AND METHODS

The studies were conducted on the bases of, 2nd clinics of Tashkent Medical Academy. 72 (72 eyes) male and female patients with concomitant diseases of the circulatory system aged 60 to 80 years have been examined (mean age 68.2 ± 3.2 years). 43 men (63%), 29 women (37%) patients were divided into two groups depending on ongoing surgical treatment. The first group consisted of 36 (36 eyes) the patients operated for glaucoma with high intraocular pressure and the second group consisted of 36 (36 eyes) patients prepared for cataracts surgery. The first group of patients was performed antiglaucomatous operations, and patients in the second group – extracapsular cataract extraction with implantation of intraocular lenses. All patients for 30 min before the operation were performed intramuscular premedication (diphenhydramine 0.1 mg/kg, diazepam 0.25 mg/kg or droperidol 0.125 mg/kg and nonnarcotic analgesics).

The patients of both groups, depending on which local anesthetic for retrobulbar blocking were divided into three subgroups for 12 (12 eyes) patients. The first subgroup (control) were the patients, 2% lidocaine 8-10 ml used as a local anesthetic. The second subgroup of patients used 2-5 ml of 0.5% bupivacaine. The third subgroup of patients received conductive anesthesia applied with 2-5 ml of 0.5% longocaine solution.

To study the effects of local anesthetics on intraocular pressure and hydrodynamics of the eyes the patients underwent tonometry (tonometer by Maklakov with 10 g load) and tonography (by Nesterov) before and 10 minutes after retrobulbar anaesthesia. The activity of local anesthetics with regional anaesthesia of the eyeball was assessed on presence of ptosis, absence of eyeball movement in all directions and reducing the sensitivity of the eyeball.

The following values were studied:

- rate of onset of anaesthesia,
- duration of full anaesthesia,
- total duration of anaesthesia,
- depth of anaesthesia.

The first definition of eyeball sensitivity was carried out after 2 minutes, then 5, 8, 10 min and subsequently every 5 min during anaesthesia.

Full eyeball anesthesia was conditionally defined as the lack of wink reflex and eyeball movements, decreased intraocular pressure. Total duration of anaesthesia eyeball determined since the lack of sensitivity, which is measured by the length of time since reducing the sensitivity of the eyeball to return to its thresholds. Depth of eyeball anesthesia characterized reduction of sensitivity and intraocular pressure.

Statistical processing of the obtained results, was carried out using generally accepted statistical methods, which included an assessment of the arithmetic mean (m), medium error, arithmetic mean (m), average standard deviation (s). To evaluate Inter-group differences Student's t-criterion was applied.

III. RESULTS AND DISCUSSION

Total duration of anaesthesia of the eyeball under 2.0% lidocaine was 30-45 min, 0.5% bupivacaine - from 120 to 180 min, 0.5% longocaine - from 120 to 180 minutes (Table no. 1). Full eyeball anesthesia was significantly shorter than the total duration of anaesthesia and began 2 min after the introduction of 0.5% bupivacaine and 0.5% longocaine. The longest full eyeball anesthesia was achieved with the introduction of 0.5% bupivacaine and longocaine. 2.0% lidocaine showed shortage in 3.4 times.

Total duration of anaesthesia of the eyeball under 0.5% bupivacaine and longocainewas significantly shorter than2% lidocaine. 2% lidocaineanesthesia requires the quantity of drug of 8-10 ml. The application of such quantity of drug has often led to the development of conjunctivalchemosis and retrobulbar swelling. Frequency of chemosis and retrobulbaredeema during anesthesia with 2% solution of lidocaine was observed at 4 (12.5%) patients. Bupivacaine and longocaine did not lead to such complications. The total duration of anaesthesia of the eyeball under the effect of bupivacaine and longocaine (0.5%) was in average 3 times longer than when applying 2% lidocaine.

Table1The comparative characteristics of the studied anesthetics

Medication	Concentration of solution %	Rate of anesthesia, min	Duration of full anesthesia, min (min)	Fullduration of anesthesia (min)
Lidocaine	2.0	5-8	8.8 ± 0.9 *	30.1 ± 1.4 *
Bupivacaine	0.5	2-5	3.2 ± 0.5 *	120.6 ± 1.8 *
Longocaine	0.5	2-4	3.3 ± 0.5 *	120.9 ± 2.0 *

Note: * - differences compared with the control group (lidocaine) (P<0.05)

As it turned out, 0.5% bupivacaine and longocaine have expressed anesthetic properties. These drugs caused a good relaxation and resulted in a significant reduction in IOP, lowering the true optalmotonus, caused by expressed declining of watery moisture production. Hypotensive effect of these drugs noted when measuring the intraocular pressure with Maklakov's tonometer confirmed data on tonography by Nesterov: patients in the second and third subgroups during operation, true intraocular pressure reliably fell mainly due to reduction of the minutes of

the aqueous humor (33%) and the simultaneous increase of the coefficient of outflow (21.9%). When using 2% lidocaine a slight decrease in IOP has been noted (table no. 2).

Thus 0.5% bupivacaine and 0.5% longocaine in addition to rapid and prolonged anaesthetic effect and have the hypotensive properties which is important on abdominal operations in ophthalmology.

Table 2: Comparative analysis of action of studied anesthetics on IOP, eye hydrodynamics before and after anaesthesia in patients with cataract

IOP value and tonometry	Norm	Surveyed group					
		I		II		III	
		Before	After	Before	After	Before	After
Tonometric pressure mm Hg (Pt)	17-26	22.0 ± 0.04	21.0 ± 0.02	23.0 ± 0.07	18.0 ± 0.05	23.4 ± 0.05	18 ± 0.04*
True IOP mm Hg (Po)	9-21	14.0 ± 0.56	13.8 ± 0.56	15.3 ± 0.72	12.9 ± 0.84	15.4 ± 0.7	12.8 ± 0.3 *
Coefficient of the outflow ease mm ³ /min/ mm Hg	0.18-0.45	0.31 ± 0.14	0.43 ± 0.14	0.29 ± 0.11	0.41 ± 0.02	0.28 ± 0.19	0.43 ± 0.21
Minute aqueous humor volume mm ³ /min	1.6 - 4.0	3.46 ± 0.28	3.30 ± 0.30	3.43 ± 0.19	2.32 ± 0.14	3.38 ± 0.18	2.18 ± 0.14*

Note: * - differences compared with the control group (P <0.05)

Table 3: Comparative analysis of action of studied anesthetics on IOP, hydrodynamics eyes before and after anaesthesia in patients with glaucoma

IOP value and tonometry	Standard rate	Surveyed group					
		I		II		III	
		Before	After	Before	After	Before	After
Tonometric pressure mm Hg (Pt)	17-26	38.9 ± 1.5	37.2 ± 1.4	37.1 ± 1.2	28.0 ± 1.5	36.3 ± 2.0	29.0 ± 1.4 *
True IOP		36.3 ± 1.57	34.8 ±	35.1 ±	22.7 ±	35.7 ± 0.72	24.4 ± 2.8

mm Hg (Po)	9-21		2.1	1.7	1.9		*
Coefficient of the outflow ease mm ³ /min/ mm Hg	0.18- 0.45	0.09 ± 0.01	0.18 ± 0.01	0.08 ± 0.01	0.21 ± 0.02	0.10 ± 0.01	0.22 ± 0.02
Minute aqueous humor volume mm ³ /min	1.6 - 4.0	4.46 ± 0.08	4.49 ± 0.03	4.48 ± 0.09	3.50 ± 0.09	4.55 ± 0.08	3.17 ± 0.07 *

Note:* – differences compared with the control group (P <0.05)

The study showed that retrobulbar introduction of drugs considerably vary in anesthetic action on the eyeball.

Most authors suggest that anesthesia of the eyeball under the action of 2% lidocaine lasts 30-45 minutes. Taking into account the duration of the deep (full) anaesthesia of the eyeball, less pronounced reduction of sensitivity has been ignored, i.e. a period of restoration of its threshold values. It is important to consider when addressing only the pain sensitivity of the eyeball, which has a low threshold and minimum concentrations of painkillers. Deep anaesthesia of the eyeball turns in addition to pain, tactile, thermal and pressor sensitivity.

When conducting surgical operations that require deep prolonged anesthesia, 0.5% bupivacaine (marcaine, Astra, Sweden) can be successfully introduced. 0.5% longocaine solution (bupivacaine hydrochloride, Yuria Pharm, Ukraine) – drugs with expressed anesthetic properties.

IV. CONCLUSIONS

1. Study of local anesthetic activity of drugs used in ophthalmic surgery, found that the most effective is 0.5% solution of bupivacaine and 0.5% solution of longocaine, which cause deep anaesthesia of the eyeball with prolonged action.
2. Bupivacaine (0.5%) and longocaine (0.5%) during anesthesia lowers IOP by lowering aqueous humor secretion, improving the aqueous humor outflow ease factor, which helps to prevent complications from the eye during surgery and in the postoperative period.
3. Retrobulbar injection of lidocaine (2%) causes full anesthesia of the eyeball with a shorter duration of action and has side effects as chemosis and retrobulbarconjunctival swelling. The drug does not cause proper myoplegia and its hypotensive effect is negligible.

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