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ORIGINAL RESEARCH **REGIONAL ANESTHESIA**

Ophthalmological disorders after spinal anesthesia

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Abstract

Background & Objective: Spinal anesthesia (SA) administered for non–ophthalmic operative surgeries has been associated with ophthalmological disorders in up to 0.2% cases. However, the incidence of medical lawsuits related to these issues amounts to 2–3%, which suggests a probable higher frequency of such violations.

This study was conducted to find the nature of ophthalmological disorders during SA and risk factors for their development during non–ophthalmic surgical interventions.

Methodology: A prospective cohort non–intervention study was carried out in 150 adult patients undergone non–ophthalmic surgical interventions under SA for analysis of state of the visual organs during SA.

Results: Ophthalmological disorders after SA were recorded in 6.7% of the patients. These disorders were of a transient nature and were no threat to the development of life–threatening dysfunctions or persistent disablement. They were directly related to the level of systemic arterial pressure. A correlation analysis demonstrated the presence of relation between the reduction in ophthalmotonus and perfusion pressure of the eyes and the administration of 0.5% bupivacaine (R = 0.7, p = 0.01).

Conclusion: The results of our study prove that the individuals with prior visual organ disorders are expected to have a relatively high incidence of ophthalmological complications after spinal anesthesia, requiring the individualization of anesthesia regimes.

Key words: Visual organs; Anesthesia, spinal; Complications

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1. Introduction

Ophthalmological disorders after spinal anesthesia (SA) in the case of non–ophthalmic operative surgeries are considered to be rare, but major complications. Scientific publications report that their frequency in certain areas of surgery reaches 0.2%. In the developed countries, the incidence of such complaints amounts to 2–3% of all medical lawsuits, inviting an assumption that the real incidence of such disorder might be much greater.[1]

The most common visual organ complications after perioperative anesthesia include lagophthalmos, hypolacrimation, blockade of spontaneous eye movements, drying, and traumatic injury to the cornea. Such injuries are often missed as they are of parenthetic nature. Mechanical, chemical trauma, and ischemic neuropathy of the optic nerve are considered to be the most severe injuries.[1,2]

The disorders may be caused by the systemic reactions due to SA. However, the data on the incidence of such disorders is inconsistent, and the information on the prevention is very limited, that is why the appropriate studies are so required.

We aimed to find the incidence and nature of ophthalmological disorders after the SA for non–ophthalmic operative surgeries.

2. Methodology

During 2018–2021, a prospective cohort non–interventional study was carried out in Poltava Medical Institutions (Ukraine), with 150 patients engaged. To determine the sample size, the following recommendations were used:[3]

The patients underwent a dynamic analysis of the functional state of the visual organs during SA, depending on the type of local anesthetic agent introduced. The study group included the patients aged from 38 to 75 y who underwent planned venotomy for chronic insufficiency of the veins of lower extremities, and who gave their consent to participate in the study. In the study group 83 (55.3%) of patients were women, 67 (44.6%) were men. Exclusion criteria included the past history of ophthalmologic pathology, and at the time of examination the presence of hemodynamically significant changes of the cardiovascular system, and the change in the plan of anesthetic management during the surgery.

Before the study, the patients or their legal representatives provided written consents for participation in the study. The study was approved by the local bioethics committee and coincided to the principles set forth in the Helsinki Declaration as amended.

All the patients underwent SA. The puncture was performed in the lumbar spine through the midline access at the L2–3 or L3–4 space with “Quincke” type 26G needles. Isobaric solution of local anesthetic was used for SA: 2% lidocaine (n = 65) or 0.5% bupivacaine (n = 85). All the medications were used in doses following t the manufacturer's instructions approved by the orders of the Ministry of Healthcare of Ukraine and constituted 1 mg/kg for 2% of lidocaine solution and 0.15 mg/kg for 0.5% of bupivacaine solution. The surgery lasted for 1.4 ± 0.4 h (Me = 1.5, 50L = 1.1, 50U = 2.0).

All clinical cases included a standard perioperative monitoring according to the primary accounting records form No. 003–3/o “Preoperative examination by an anesthesiologist and min of general anesthesia” approved by the Order No.110 of the Ministry of Healthcare of Ukraine as of February 14, 2012, as well as verification of the type and nature of pharmacological support of anesthesia. The monitoring included perioperative assessment of oxygen saturation (SpO_2) and noninvasive systolic (SAP), diastolic (DAP), and mean blood pressure (MAP) with a patient monitor YM 300–12 (LLC “Company “Yutas”, Ukraine).

Ophthalmological clinical and instrumental examination was carried out before and in 2 h after anesthesia by ophthalmologists of the relevant medical and preventive care institutions including:

a. Examination by an ophthalmologist using the panoramic ophthalmoscope «PanOptic» Welch Allyn (USA)

b. Ophthalmotonometry using the intraocular pressure indicator IGD–02 "PRA" Diathera (Russia) with the further calculation of perfusion pressure of the eyes, being calculated as the difference between MAP and intraocular pressure

c. Assessment of the quality of tear film for the time of its rupture using the portable Placido keratoscope

d. Assessment of the volume of basic secretion of the tear film using the Schirmer test with blotting paper

e. Defining the vision acuity using the Golovin–Sivtsev table with further calculation according to Snellen

f. Examination of the chromatic sensation using the Rabkin tables

g. Assessment of peripheral vision by the ‘orientative method’ of visualization of the object, and

h. Examination of binocular vision using the ‘fixative eye movements’ method.

Statistical analysis: The processing of the results was carried out in the Microsoft Office Excel 2003 software package. The nature of the mathematical data distribution was considered to be different from the standard one, and the nonparametric methods of statistical assessment of the data were applied, accordingly: median (Me), quartile (50L, 50U), a criterion for signs with the assessment of the sum of atypical shifts associated with the critical value (G), χ^2–test. The establishment of correlation relations between the phenomena was made using the Spearman correlation coefficient (R). In the course of statistical processing of the data, the minimum level of error–free forecast was $p = 0.95$ and the level of first kind error – $p \leq 0.05$, accordingly.

3. Results

Ophthalmological disorders after SA were recorded in 10 cases out of 150 (6.7%). These disorders constituted a problem in the postoperative period in terms of comfort of the patient, but were of a transient nature and were no threat to the development of life–threatening dysfunctions or permanent disablement. The nature of these disorders is presented in the Table 1.

Risk factors for ophthalmic complications were empirically considered as gender, age, duration of surgery, spinal blockade, and blood pressure. Among the examined patients, 66% were women (99/150) and 34%

were men (51/150). The age of the patients was 60 y (49–66), the duration of the operation was 76 min (62–101), the duration of the sensory block was 92 min (82–101), the minimum level of SAP was 101 mmHg (92–118), DAP – 66 mmHg (64–76), MAP – 72 mmHg (64–89). In 23% of patients (35/150), AP indicators during surgery decreased by more than 20%, which was regarded as hypotension, but did not require additional correction methods. The time of such hypotension was 7 min (5–16). These indicators became assessment points for identifying risk factors for ophthalmic complications when assessing the effectiveness of surgical interventions (Table 2).

Table 2 demonstrates that the occurrence of ophthalmic problems is primarily associated with the duration of the spinal block and hemodynamic changes (decrease in DAP, MAP and duration of hypotension). This is confirmed by the correlations between the ophthalmotonus and the level of blood pressure: SAP (R = 0.5, p = 0.04), DAP (R = 0.4, p = 0.04), MAP (R = 0.6, p = 0.02).

It has been suggested that various anesthetic agents influence the formation of ophthalmological disorders differently. A correlation analysis demonstrated the presence of relation between the reduction in ophthalmotonus and perfusion pressure of the eyes and the administration of bupivacaine (R = 0.7, p = 0.01).

Table 1: Indicators of the state of the visual organs after SA (n=150)

Indicator	Before surgery			In two hours after surgery			Number of shifts			G	p
	Me	50L	50U	Me	50L	50U	Zero	Typical	Atypical		
Ophthalmotonus (mmHg)	33	29	37	24	18	28	5	111	32	55	< 0,01
Perfusion pressure of the eyes (mmHg).	75	62	80	65	60	72	22	80	48	50	< 0,05
Time of rupture of the tear film (sec)	32	27	34	30	25	36	31	64	55	45	> 0,05
Basic secretion of the tear film (cm)	1,2	1,1	1,3	1,3	1,1	1,4	0	80	70	64	> 0,05
Visual acuity (conventional units)	1,0	1,0	1,0	0,9	0,9	1,0	2	82	66	59	> 0,05

Table 2: Evaluation of risk factors for ophthalmic complications in non–ophthalmic surgery

Index	Study groups		χ2	p
	With ophthalmic disorders (n=10)	Without ophthalmic disorders (n=140)		
Gender: Female	6/10	93/140	0.17	0.67
Age over 60	7/10	76/140	0.93	0.33
The duration of the operation is more than 76 min	5/10	65/140	0.05	0.83
The duration of the sensor block is more than 92 min	6/10	39/140	4.59	0.03
SAP is less than 101 mmHg.	5/10	31/140	3.97	0.05
DAP is less than 66 mmHg.	9/10	77/140	4.67	0.03
MAP is less than 72 mmHg.	7/10	43/140	6.48	0.01
Hypotension less than 20% of baseline blood pressure	4/10	31/140	1.66	0.2
Duration of hypotension more than 7 min	4/10	13/140	8.76	0.03

4. Discussion

The study shows that the incidence of ophthalmological disorders amounts to 6.7%. This incidence is greater than that reported in earlier studies.[1,2] As the ophthalmological disorders after anesthesia are mostly transient and do not have lethal and disabling effects, so they are not recorded. It may explain the difference in the data obtained.

The possibility of development of serious disturbances in the circulatory system of the visual organs due to the low blood pressure, can be confirmed by the connection found between the reduction in ophthalmotonus and perfusion pressure of the eyes and systemic arterial hypotension. The cases of development of blindness according to the similar mechanism have been recorded.[4–6]

It is important to note that the decrease in ophthalmotonus and perfusion pressure of the eyes was basically related to the administration of bupivacaine, which is also confirmed by other authors.[6] Such results may be explained by the greater cardiotoxicity of bupivacaine, and, possibly, longer duration of the sympathetic block. Although some authors state that the hemodynamically significant changes in the case of SA depend not so much on the dose and cardiotoxicity of the local anesthetic agent as on the level of the spinal block.[8,9]

Thus, ophthalmological disorders after SA occur more frequently than previously thought. These changes are transitory and do not pose an immediate threat to the life and work capacity of the patient.

Ophthalmological disorders after SA include the change in the perfusion of the eye balls, related to the fluctuations in

systemic blood pressure and are more peculiar to bupivacaine. Based on the results of this study, the individuals with ophthalmological disorders are expected to have greater incidence of ophthalmic complications after SA and require the careful selection of the anesthetic techniques.

5. Conclusions

The results of our study show that the frequency of ophthalmological disorders after spinal anesthesia is about 6.7%; and these are related to the changes in the perfusion of the eye balls, which is directly related to the systemic arterial hypotension. This chain of reactions is more significant with bupivacaine compared to lidocaine. However, the disorders are transient and pose no direct threat to the life or work capacity of the patients.

6. Conflict of interest

None declared by the authors

7. Authors' contribution

DAK: Concept, conduct of study

DAS: Supervision, manuscript writing

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