ECRONICON OPEN ACCESS

EC OPHTHALMOLOGY
Research Article

The Effectiveness of Xenon Sedation in Laser Refractive Interventions on the Cornea

VV Myasnikova[1,2]*, SN Sakhnov[1,2], AV Romanov[1] and OA Klokova[1]

[1]S Fyodorov Eye Microsurgery State Institution, Krasnodar, Russia

[2]Kuban State Medical University, Ministry of Health of the Russian Federation, Krasnodar, Russia

***Corresponding Author:** VV Myasnikova, Deputy Director, S.N. Fyodorov IRTC Eye Microsurgery, Associate Professor, Kuban State Medical University, Krasnodar, Russia.

Received: January 29, 2024; **Published:** March 04, 2024

Abstract

Laser refractive surgery has gained popularity due to the ability to quickly and safely perform surgical correction of myopia, hyperopia and various forms of astigmatism. Local anesthetics effectively eliminate pain syndrome, but they cannot affect increased psychoemotional anxiety before surgery. Moderate sedation, anesthesia, stress-limiting effect and the possibility of maintaining the patient's consciousness and contact with him, make xenon an alternative to general anesthesia.

Our randomized study involved 2 groups: the main group (n = 29), in which xenon sedation was performed in sub-narcotic dosages; and the control group (n = 20), in which 25 mg hydroxyzine premedication was performed. Blood cortisol taken immediately before and immediately after surgery was measured in the laboratory. Capillary glucose levels were measured simultaneously with cortisol. To assess the stress level using the analysis of heart rate variability "varicard", a stress index and an indicator of the activity of regulatory systems were used. Examination of patients using the "cardiovisor" device (Russia) allowed us to study vegetative reactions under stress, which manifest themselves primarily in the form of changes in cardiovascular parameters. The indices "myocardium" and "rhythm" characterize the total amount of variance deviations from the norm.

After xenon sedation, cortisol levels decreased after surgery ($p = 0.02$). In the main group, the activity index of regulatory systems decreased after xenon sedation ($p = 0.003$). In the control group, an increase in this indicator was noted ($p = 0.002$). The stress index decreased after xenon sedation ($p < 0.01$). And in the control group, the stress index increased ($p < 0.01$). The indices "myocardium" and "rhythm" also significantly decreased in the group with xenon sedation ($p = 0.03$) ($p < 0.01$), respectively, compared with the control group.

Conducting such preoperative preparation as xenon sedation guarantees the safe conduct of laser ophthalmological interventions in emotionally labile patients.

Keywords: *Sedation; Laser Refractive Interventions; Anxiety; Xenon*

Introduction

Laser refractive surgery has gained popularity due to the ability to quickly and safely perform surgical correction of myopia, hyperopia and various forms of astigmatism. Traditionally, terminal (surface) anesthesia of the cornea is used during laser operations. Local anesthetics effectively eliminate pain syndrome, but they cannot affect increased psychoemotional anxiety before surgery.

In practice, anxiolytic drugs, intravenous sedation and general anesthesia are used in ophthalmological clinics to solve the problem of eliminating the psycho-emotional stress of patients during laser operations. Xenon has proven itself well as an anesthetic used in outpatient surgery. The positive effect of xenon anesthesia is manifested by rapid awakening and promotes intraoperative and postoperative analgesia [2]. But the limited use of xenon due to its high cost causes a shortage of information about it.

The use of xenon in surgical interventions in ophthalmology provides a more stable course of anesthesia with a quick comfortable awakening and fewer undesirable side effects [3]. Xenon has a significant analgesic effect, increasing the safety and satisfaction of patients with anesthesia [4]. Inhalation of a xenon-oxygen mixture (with a low xenon content of 25%) also helps to reduce the intensity of postoperative pain and increase the pain threshold [5]. In addition, xenon has neuroprotective and anti-inflammatory effects due to the inactivation of GSK-3β (glycogen synthase kinase-3 beta) [6]. The obvious advantages of xenon are: odorless, easily and quickly excreted from the body, not metabolized in the body, does not cause allergic reactions. Xenon does not have a depressing effect on the parameters of the cardiovascular system, thereby ensuring the stability of hemodynamics [7].

Aim of the Study

The aim of the study is to substantiate the effectiveness of the xenon sedation method for the correction of neurotic stress-related disorders during laser vision correction operations (ReLEx® SMILE, Lasik, FemtoLASIK).

Materials and Methods

Our randomized study involved 2 groups: The main group (n = 29), in which xenon sedation was performed in sub-narcotic dosages; and the control group (n = 20), in which 25 mg hydroxyzine premedication was performed. Local anesthesia technique: terminal anesthesia of the eye surface was performed 10 minutes before surgery twice at equal intervals with a local anesthetic oxybuprocaine ("Inocaine" 4 mg/1 ml).

The patients in the groups were homogeneous in age (from 18 to 32 years, mean age 22.76 ± 1.43 years) and gender (46 women and 43 men).

Criteria for inclusion in the study: Patients with a high degree of anxiety (more than 46 points on the Spielberger-Hanin scale) [1]. The patient filled out two questionnaires before surgery: one to measure indicators of situational anxiety, and the second to measure the level of personal anxiety.

Xenon sedation technique: The first stage is denitrogenation for 7.5 ± 2.3 minutes. Sedation was performed with a closed-circuit anesthesia machine XENA-010 (Russia). The target concentration of xenon in the respiratory circuit with respect to oxygen is 40% and is reached within 10 - 12 minutes. The stage of deep sedation (the patient is drowsy or asleep) occurs 17 - 23 minutes after the xenon is connected.

Blood cortisol taken immediately before and immediately after surgery was measured in the laboratory. The study was carried out using a set of reagents for enzyme immunoassay determination of cortisol concentration in blood serum Cortisol-ELISA-BEST (Russia). Capillary glucose levels were measured simultaneously with cortisol with a DIACONT 2598 glucometer (Taiwan).

To assess the stress level using the analysis of heart rate variability "varicard", a stress index and an indicator of the activity of regulatory systems were used. These are the most meaningful indicators of the tension of regulatory systems caused by the activation of the pituitary-adrenal system and the reaction of the sympathoadrenal system in response to any stressful effect. The study was performed 30 minutes before surgery and 30 minutes after surgery.

Examination of patients using the "cardiovisor" device (Russia) allowed us to study vegetative reactions under stress, which manifest themselves primarily in the form of changes in cardiovascular parameters. This is a method of non-invasive monitoring of the functional state of the heart, based on computer calculation (models) and three-dimensional visualization of "portraits of the heart" based on low-amplitude fluctuations of a standard ECG recorded by leads from the extremities. The indices "myocardium" and "rhythm" characterize the total amount of variance deviations from the norm. The higher the index value, the greater the deviation from the norm. The indicator "rhythm" = 100% corresponds to the most pronounced changes in the regulation of heart rhythm, characteristic of severe arrhythmias or severe stress. The study was conducted immediately after the "varicard" examination.

To statistically assess changes in blood glucose and the rhythm index, the student's paired criterion was used, since the sample had a normal distribution. The Wilcoxon criterion was used for the indicator of activity of regulatory systems, the stress index, and the myocardium index, since the sample had an abnormal distribution. The differences were considered statistically significant at $p < 0.05$.

Results

In the main group, during surgical interventions, patients, while remaining fully conscious, behaved adequately and calmly, did not experience anxiety and pain. In no case was the cancellation or postponement of the operation required. The planned refractive result was achieved in 100% of cases. In the control group, two patients failed to have surgery. On the operating table, the patients lay quietly, but they constantly moved their eyes and could not focus on the fixation point, explaining this by excitement.

In the xenon group, cortisol levels decreased after surgery from 424.8 [260.4; 589.2] to 271.9 [120.4; 423.3] nmol/l ($p = 0.02$). In the control group, the cortisol level after surgery increased from 205.5 [107.2; 303.8] to 309.5 [157.9; 461.1] nmol/l ($p = 0.03$). In the main group, the glucose level was 13% higher than at the beginning of the operation ($p = 0.022$). There were no statistically significant changes in the control group (a decrease of 4.2%).

In patients of the main group, the indicator of activity of regulatory systems decreased from 5.9 [4.8; 7] to 3.2 [1.3; 5.1] units ($p = 0.003$). In the control group, this indicator increased after surgery from 5.5 [4.5; 6.8] to 8.2 [6.9; 10] ($p = 0.002$). In the main group, the stress index decreased from 55 [41.5; 68.5] to 28 [14.5; 41.5] ($p < 0.01$). In the control group after surgery, this indicator increased from 52.3 [37.3; 66.8] to 130.8 [79; 182.6] ($p < 0.01$). In the main group, there was a decrease in the myocardial index by 13% ($p = 0.03$). In the control group, the myocardial index increased by 3.4% after surgery ($p = 0.04$). In the xenon group, the rhythm index decreased from 14 [10; 18] to 12 [9; 15]% ($p < 0.01$). In the control group after surgery, the rhythm index increased from 41 [26; 56] to 82 [70; 94]% ($p < 0.01$).

Discussion

Since patient satisfaction is a key factor in performing vision correction operations, adding a quality of life assessment to traditional ophthalmological examinations allows for a more detailed assessment of patient treatment outcomes. Patient satisfaction with anesthesiological care remains the best way to assess performance from the point of view of patients, being an important parameter of the quality of hospital care. When assessing the level of patient satisfaction with xenon anesthesia in comparison with intravenous sedation during SMILE laser vision correction surgery, the well-being of patients in the xenon group was significantly higher [8].

The presented results show the effectiveness of preoperative xenon inhalation in patients with initially high levels of anxiety. In the operating room, stable hemodynamics could be noted against the background of preoperative preparation, patients remained in contact, lay quietly on the operating table and did not interfere with the surgeon at the stages of surgery. The cortisol level after surgery in the main group was significantly lower than the baseline. The concentration of cortisol, as a stress marker, in the blood correlated with the

degree of surgical injury. During examination on a "varicard" and a "cardiovisor" in the xenon group, a decrease in the activity index of regulatory systems, the voltage index of regulatory systems, the indices "myocardium" and "rhythm" after surgery was noted, which shows effective nociceptive and anti-stress protection of xenon inhalation. Cortisol is involved in the regulation of carbohydrate metabolism, and a decrease in cortisol secretion reduces glucose synthesis in hepatocytes. But in our study, the results of glycemia were ambiguous, which may be due to the different metabolic levels of the patients.

Conclusion

A statistically significant decrease in the studied values (cortisol level, activity index of regulatory systems, stress index of regulatory systems, as well as the "myocardium" and "rhythm" indices) proves effective nociceptive and anti-stress protection against the background of xenon sedation before laser refractive interventions in patients with severe anxiety. Carrying out such preoperative preparation guarantees the safe conduct of laser ophthalmological interventions in emotionally labile patients.

Bibliography

1. Gerasimova YY and Ermakov MA. "Neuroprotective effects subarcticus and drug concentrations medical xenon". *Vestnik SMUS* 3.18 (2017): 21-24.

2. Wu L., *et al*. "Lasting effects of general anesthetics on the brain in the young and elderly: "mixed picture" of neurotoxicity, neuroprotection and cognitive impairment". *Journal of Anesthesia* 33.2 (2019): 321-335.

3. Myasnikova VV., *et al*. "Xenon laryngeal mask anesthesia in ophthalmosurgery". *Russian Journal of Anesthesiology and Reanimatology* 4 (2018): 64-68.

4. GR Abuzarova., *et al*. "Double-blind, randomized, placebo-controlled study of Xenon in cancer pain therapy". *Annals of Critical Care* 4 (2020): 48-57.

5. Potievskaya VI., *et al*. "Assessment of xenon effect on postoperative pain syndrome severity in oncological patients: a randomized study". *Annals of Critical Care* 3 (2021): 140-150.

6. Ershov AV., *et al*. "The effect of xenon on the activity of glycogen synthase kinase-3β in the perifocal zone of ischemic cerebral infarction (Experimental study)". *General Reanimatology* 19.2 (2023): 60-67.

7. Lisichenko IA and Gusarov VG. "Choice of anesthesia for orthopedic surgery in elderly and senile patients (Review)". *General Reanimatology* 18.3 (2022): 45-58.

8. Myasnikova VV., *et al*. "Patient satisfaction with anesthesia during laser vision correction by the SMILE method". *Modern Problems of Science and Education* 6 (2023).

Volume 15 Issue 3 March 2024