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# Changes in the function of the visual organs in the acute period of traumatic brain injuries, according to the Glasgow scale.

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**Relevance of the problem.**

Traumatic brain injury (TBI) is one of the pressing problems of medicine, leading to the development of neurological and ophthalmological complications, which are the direct cause of decreased ability to work and disability of victims (Ydyrysov I.T., Kalyev K.M. 2018). A feature of visual organ trauma is its combination with damage to many brain structures and the specificity of the damaging agent, leading to the development of mechanical and chemical damage. Many new specific clinical signs have emerged in traumatic brain injury (TBI), which have been little studied. In TBI, ophthalmopathology is represented mainly by damage to the optic nerve. One of the pathogenetic factors of traumatic disease after TBI is a violation of autoregulation of cerebral blood flow. Traumatic brain injury (TBI) leads to damage to the visual analyzer in up to 20% of cases. (Aznabaev B.M., Latypova E.A. 2015; Yatsenko O.Yu. et al. 2017; Akmataliev A.A., Bektash U.U. 2018). Is it possible to predict the preservation of visual functions in various types of TBI, what changes occur in central hemodynamics and liquorodynamics, and how do they affect visual functions? These and many other questions are poorly reflected in modern ophthalmological literature (Stern M.V., Sharova E.V., Zhavoronkova L.A., Dolgikh V.T., Kuzovlev A.N., Pronin. 2023).

**Purpose of the study**.

To establish patterns of ophthalmological examinations during the acute period of traumatic brain injury according to the Glasgow scale in the hospital..

**Material and methods**. Under our supervision, from 2020 to 2022, 1368 patients with TBI were admitted to the emergency neurosurgery department of the FFRCEMP. Victims in an agonal and extremely severe condition, with suppression of the level of wakefulness to the point of atonic coma (up to 3 points on the Glasgow Coma Scale - GCS) were excluded from the study; surgical intervention was not possible due to the severity of the condition. There were 62.3% men, 37.7% women. The patients were distributed by age as follows: from 18 to 20 years - 83, from 20 to 30 years - 410, from 30 to 40 years - 465, from 40 to 50 years - 84, from 50 to 60 years - 211, from 60 to 70 years old - 63, older 70 years old - 52 patients. The patients underwent an examination, including examination by a multidisciplinary team (neurosurgeon, maxillofacial surgeon and ophthalmologist), neuro-ophthalmological examination, CT, MRI of the brain and orbits, ultrasound of the eyeball and retrobulbar fat. Concussion was detected in 731 (53.5%) patients. Moderate brain contusion 528 (38.6%), severe brain contusion 105 (7.7%). To predict the outcomes of patients who suffered a brain injury, impairment of consciousness and the severity of coma, the Glasgow scale was used (Table 1).

According to the Glasgow scale, the following results have been developed:

**Table 1**

| № | Result | Points gained | Absolute number | Percent % |
|---|---|---|---|---|
| 1. | Consciousness clear | 15 points | 837 | 61,2 |
| 2. | Moderate stun | 14 - 13 points | 318 | 23,3 |
| 3. | Deep Stun | 12- 11 points | 94 | 6,9 |
| 4. | Sopor | 10 - points | 57 | 3,8 |
| 5. | Moderate coma | 7 - 6 points | 36 | 2,9 |
| 6. | Deep coma | 5 - 4 points | 26 | 1,9 |

The scale consisted of three tests assessing the eye opening reaction (E), as well as speech (V) and motor (M) reactions.

For each test a certain number of points were awarded. In the eye opening test - from 1 to 4, in the speech reactions test - from 1 to 5, and in the motor reactions test - from 1 to 6 points. Thus, the minimum number of points is 4 (deep coma), maximum -15 (clear consciousness).

Opening your eyes (E, Eye response)

- free - 837
- Reaction to voice - 412
- Reaction to pain - 57
- No reaction - 62

Manifestations of changes in visual function of traumatic brain injury depend on the nature of the damage. The diagnosis of concussion is made based on medical history. Typically, the victim reports that there was a blow to the head, which was accompanied by a short-term loss of consciousness and a single vomiting. The severity of the concussion was determined by the duration of loss of consciousness - from 1 minute to 20 minutes. At the time of examination, 837 patients were in a clear state, 15 points on the Glasgow scale, of which 478 patients had no changes in vision. In 32 patients with decreased vision, ocular concomitant pathology was primarily identified. These patients, after being discharged from the emergency hospital, were sent for treatment and vision restoration to an ophthalmologist as planned. In 27 patients 0.7-0.2, concomitant ocular pathology was determined according to the life history. For two weeks after the concussion, weakness, increased fatigue, sweating, irritability, and sleep disturbances were observed.

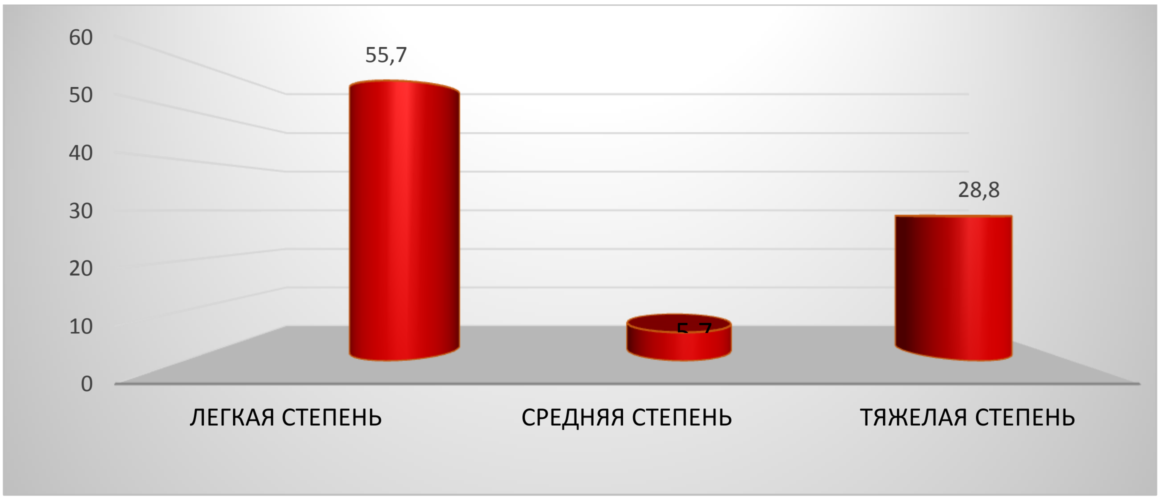
With a mild cerebral contusion, the victims lost consciousness for an hour, and then complained of headache, nausea, and vomiting. Twitching of the eyes was noted when looking to the side; vision was determined to be from 08 to 0.5, depending on which part of the brain was affected. Roentgenoscopy and MSCT of the brain showed a fracture of the bones of the cranial vault, and there was an admixture of blood in the cerebrospinal fluid (cerebrospinal fluid is a transparent liquid that surrounds the brain and spinal cord and also performs protective functions).

A brain contusion of moderate severity is accompanied by loss of consciousness for several hours; patients do not remember the events preceding the injury, the injury itself and what happened after it; they complain of headache and repeated vomiting. There was a decrease in vision to 0.08, uneven pupil size, and speech impairment. Instrumental studies show fractures of the vault or base of the skull, subarachnoid hemorrhage.

With a severe brain contusion, 78 victims lost consciousness for 1–2 weeks. The state of consciousness according to the Glasgow coma scale of I, II, III degrees was noted. In these patients, gross disturbances of vital functions (pulse rate, pressure level, frequency and rhythm of breathing, temperature) were revealed. The movements of the eyeballs are uncoordinated. As a rule, this condition is a consequence of fractures of the vault and base of the skull and intracranial hemorrhage.

**Analysis of the results by degree of damage to the organ of vision:**

There were 495 (55.7%) mild damage to the visual organs, 138 (15.5%) moderate damage, and 256 (28.8%) severe damage (Fig. 1). One eye was damaged in 631 patients, both eyes were damaged in 259 patients, that is, the total number of damaged eyes was 1149. The proportion of men was 85.2%, the number of injured men was the highest, 74% were classified as able-bodied. Based on this indicator, we can say that the risk of eye damage is higher in the male group (P<0.01). The main causes of injuries are road traffic accidents, the cause of motor vehicle injuries was high at 40.7%, criminal incidents exceeded 43.8%. 12 injuries were observed: combined traumatic brain injuries with damage to the organ of vision and life-threatening and dangerous to the organ of vision.




**Rice. 1. Degree of damage**

A concussion was observed in 777 (56.8%). All conscious patients with combined damage to the brain and visual organs during examination complained of redness of the eyes, sensation of a “foreign body”, lacrimation, decreased visual acuity, pain in the eyes and double vision of objects. Of the 1368 patients who took part in the study, 3 complained of lack of vision, 183 complained of a sharp decrease in vision, and 604 patients complained of a partial decrease in vision (Table 2). Impaired movement of the eyeball was observed in 127 (9.2%) patients. Diplopia and strabismus as a cosmetic defect were observed in 137 (10%) patients (Table 4).

**Table 2**

| № | Indicators | Абсолютное число (n) | Процент % |
|---|---|---|---|
| 1. | Vision is unchanged | 578 | 42,2 |
| 2. | Partial visual impairment | 604 | 44,1 |
| 3. | Significant decrease in vision | 183 | 13,3 |
| 4. | Blindness | 3 | 0,2 |

**Table 3**

| № | Visual acuity | Absolute number (n) | Percent % |
|---|---|---|---|
| 1. | 0,8 – 1,0 | 578 | 42,2 |
| 2. | 0,4 – 0,7 | 604 | 44,1 |
| 3. | 0,1 – 0,3 | 112 | 8,1 |
| 4. | 0,04 – 0,09 | 64 | 4,6 |
| 5. | 0,01 – 0,03 | 7 | 0,5 |
| 6. | 0 (zero) – pr.in.certe | 3 | 0,2 |

We paid attention to the symmetry of the location of the eyeball, its movements, the presence of diplopia, exophthalmos, enophthalmos, and the dynamics of the sensitivity of nerve fibers. Roentgenoscopy and MSCT examined the size, clarity, horizontal and vertical dimensions of the orbit.

**Table 4**

**Observation of clinical signs**

| Name of clinical sign | Absolute number (n) upon admission | Percent % | Absolute number (n) at time of discharge | Percent % |
|---|---|---|---|---|
| Diplopia | 137 | 10 | 49 | 3,5 |
| Dystopia | 143 | 10,4 | 76 | 5,5 |
| Oculomotor disorder | 127 | 9,2 | 56 | 4 |

**Conclusions.** When organizing simultaneous multi-team care and organizing a diagnostic algorithm for the volume of ophthalmological studies to conduct standard, special ophthalmological, clinical, functional and instrumental examinations, to determine the indications and scope of studies in patients with craniorbital injuries, depending on the general serious condition of the patient (Level of consciousness on a scale Glasgow) and reconstructive surgical interventions in patients admitted in the early period of IOT, in the first 2 hours the probability of complications was 0.6%, also the development of an algorithm for differentiated treatment and the use of this algorithm led to high cost-effectiveness - a sharp reduction in the number of bed days and temporary disability, which was reflected in budget savings.

According to our study, in cases of traumatic brain injury due to the presence of cerebral edema, depression of the level of wakefulness to the point of stupor and coma, the presence of oculomotor disorders, anisocoria or bilateral mydriasis, and decreased vision were observed. Based on the study, it was established that visual disturbances show degrees of severity on the Glasgow scale in cases of traumatic brain injury.

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