https://doi.org/10.31288/oftalmolzh202333437

Prospects for predicting long-term treatment outcomes in patients with combat ocular trauma

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Introduction. *The analysis of experience in changing approaches to organizing medical care for combat eye injuries, changing treatment tactics for such patients during armed conflicts in the 20th and 21st centuries, domestic experience in providing medical care for eye and its adnexal injuries, highlights the search for informative methods of predicting long-term outcomes of the applied treatment methods.*

The aim *of the study was to determine the informativeness of constructing a forecast of functional changes of the visual analyzer based on the results of treatment of patients with eye injuries during dynamic retrospective observation.*

Materials and Methods: *The primary material for the study was medical documentation of combat eye injury patients (data from medical histories, outpatient cards, and discharge summaries) for the period of 2014-2015, who were treated at the National Military Medical Clinical Center "Main Military Clinical Hospital" (NMMCC "MMCH"). Indicators of the functional state of the visual analyzer were evaluated upon admission to the NMMCC "MMCH" and after 180 days following the injury. The study used the proposed F. Kuhn and colleagues' scale for evaluating long-term treatment outcomes (OTS-Ocular Trauma Score).*

Results*. It was found that overall, the results of treatment for combat eye injuries and their adnexa at the NMMCC "MMCH" during the study period of 2014-2015 showed a high correlation with the calculated values of the probability of preserving visual functions according to the OTS scale. Almost all patients with a case of blindness remained blind in the injured eye six months later. In the group with light projection and movement of the hand near the face, an improvement in visual function in most cases (65%) was noted, while, according to the OTS scale, these patients in most cases remain in this group or move to the group with blindness. Cases with visual acuity of 0.005-0.1 after 6 months improve visual acuity with the transition in most cases to 0.1 and above. The same trend, but, as expected, with a higher probability in groups with visual acuity of 0.1-0.4 and above 0.5. The identified discrepancies justify the need for adaptation of the OTS scale for predicting functional changes in combat eye injuries, as it has been developed for use in eye injuries during peacetime.*

Conclusion: *Considering the large number of wounded soldiers with severe eye injuries during the war with rf, scientific research on the implementation of a system for predicting long-term functional outcomes of the treatment of combat eye trauma based on clinical data at the time of initial examination remains relevant. The results obtained with the OTS (Ocular Trauma Score) assessment scale in most cases correspond to the results of the treatment of injured patients in the ophthalmology clinic of the NMMCC "MMCH" in 2014-2015. Further development of the existing OTS system and its adaptation to domestic conditions and the realities of providing ophthalmic care for combat eye trauma is promising for further study.*

Keywords:

combat eye trauma, results prediction, Ocular Trauma Score

Introduction

The proportion of combat-related eye injuries during wars and armed conflicts throughout the 20th and 21st centuries has gradually increased. According to various authors, in the First and Second World Wars, the percentage of such injuries was 2-2.5%, but during the Korean War and the Vietnam War, it reached 8-9%, and during operations in Iraq and Afghanistan at the end of the 20th and beginning of the 21st centuries, it increased to 13% [1,2,3,8]. This increase is associated with the growing

use of high-kinetic-energy fragmentation ammunition, as well as the appearance of protective equipment that covers the torso, leaving the face and limbs exposed. These same factors contribute to the severity of combat trauma and injuries due to the proximity of the most critical vessels and the brain. The frequency of bilateral eye injuries is significant (up to 30%). Severe combat injuries to the eyes can cause blindness and irreversible loss of visual function (disability). The development of antibacterial therapy and surgical directions in ophthalmology (cataract, vitreoretinal surgery, oculoplasty) has had a positive impact on the treatment outcomes of combat-related eye injuries, nonetheless, given the severity of the injuries and the timing of the operative intervention, unsatisfactory treatment results (blindness, low vision) are not uncommon [4,7]. There is a need to predict the probable treatment outcomes in terms of the preservation of visual function in such patients. Predicting outcomes is useful in treatment planning, choosing a strategy and volume of surgical intervention, providing information to the patient and family about possible or expected functional outcomes in the future [5,6]. Therefore, the development and implementation of a methodology for predicting treatment outcomes in patients is a relevant topic today.

The aim of the study was to determine the informativeness of forecasting functional changes in the visual analyzer based on the results of treatment of wounded individuals with eye injuries during dynamic retrospective observation.

Materials and Methods

The primary material for the study was the medical documentation of wounded individuals (data from medical histories, outpatient cards, and discharge summaries) with combat injuries to the eye for the period of 2014-2015, who were undergoing treatment at the NMMCC "MMCH". Indicators of the functional state of the visual analyzer were evaluated upon admission to the NMMCC "MMCH" and after 180 days following the injury. The proposed F. Kuhn and colleagues' scale for assessing long-term treatment outcomes (OTS-Ocular Trauma Score) was used in the study.

Results

Since the beginning of the Russian war on Ukraine in April 2014, specialists from the National Military Medical Clinical Center "Main Military Clinical Hospital" (NMMCC "MMCH") provided specialized ophthalmological care to wounded individuals with eye injuries. The onset of hostilities was a challenge for ophthalmologists who, at that time, had no experience in treating severe combat eye trauma. During treatment, existing standards of care were adapted, and new ones were developed, including principles of evacuation and time intervals for surgical interventions.

It should be noted that all patients at the time of injury did not use eye protection (protective goggles). In most cases, specialized surgical ophthalmological care, including PHO, revision of injuries, and often vitrectomy, was performed at previous stages, namely, Dnipro Reginal Clinical Ophthalmological Hospital, The Girshman ophthalmological clinic in Kharkiv, and the Military Medical Clinical Center of the Northern region.

Evacuation from level III medical facilities was carried out by aviation and ground transportation. Upon admission, patients' condition, accompanying injuries, and distribution by departments were assessed. Thus, 108 patients with eye injuries (131 eyes) were treated at the ophthalmology clinic. It should be noted that doctors received information about the nature and severity of the injury during the patient's examination upon admission to the emergency department. Examination and distribution of patients took some time. General clinical studies, X-rays, CT scans of the skull and orbits were performed.

Distribution of injuries by type and localization of damage. According to the Birmingham Eye Trauma Terminology (BETT), which is traditionally used in NATO member countries, injuries were classified into categories. The most common injuries were penetrating (open globe) injuries in 84 (64%) cases. Non-penetrating (closed globe) injuries were diagnosed in 47 (36%) patients. Among penetrating injuries, injuries with the presence of intraocular foreign bodies (IOFBs) accounted for 37% (48) of the total number and 57% of the structure of penetrating injuries. Some IOFBs were removed at earlier stages while performing PHO.

In terms of the localization of injuries in penetrating injuries, the following zones were identified: zone 1 - cornea and limbus; zone 2 - up to 5 mm from the limbus; zone 3 - more than 5 mm from the limbus. According to this criterion, the distribution was as follows: penetrating injuries in zone 1 - 39 (46%), zone 2 - 18 (21%), zone 3 - 27 (33%).

Analysis of general treatment indicators for penetrating injuries to the visual organ. All patients with penetrating injuries received local and systemic antibiotic therapy with broad-spectrum drugs from the moment of admission. Hormones and non-steroidal anti-inflammatory drugs were also prescribed locally and systemically in the pre- and postoperative period.

Emergency surgeries were performed within the first day of admission for urgent indications, and planned surgeries were performed within 3 to 12 days. A total of 58 surgeries (65 eyes) were performed in our clinic during the period of 2014-2015. These were primarily primary, delayed surgical treatment of eye wounds, vitrectomies, and removal of crystalline lenses (phacoemulsification and phacoaspiration). During vitrectomies for injuries and trauma, foreign bodies, blood, proliferative membranes, and films were removed. Temporary intraoperative endotamponade with PFOS and subsequent intraoperative replacement with silicone oil was performed in cases of ruptures, detachments of the retina, and vascular membranes. Among the repeat (stage) surgical procedures, which amounted to 10 patients (14 eyes), silicone oil was

replaced with liquid in 8 cases, vitreal cavity revisions were performed in 2 cases, and phacoemulsification was performed in 4 cases. Additionally, 35 eyes were operated on during previous stages. During the indicated period, one case of slowly progressing endophthalmitis was treated. Evisceration or enucleation due to eye destruction was performed in previous stages. The average duration of treatment was 19.7 days in 2014 and 16.6 days in 2015. After hospital treatment, sick leave was provided to complete the treatment.

15 patients were discharged from the ranks of the Armed Forces of Ukraine after completing treatment for injuries. The main causes were low vision or blindness due to damage or atrophy of the optic nerve in 4 (26.7%) patients, subatrophy of the eyeball in 2 (13.3%), proliferative vitreoretinopathy and recurrence of retinal detachment in 2 (13.3%) patients, performed eviscerations in 3 (20%) patients, secondary glaucoma in 1 (6.7%) patient, and damage to the vascular membrane in the central region in 3 (20%) patients. Among these patients, there was one case of incorrect light projection in both eyes and one case of bilateral evisceration.

Analysis of the forecast of functional changes of the visual analyzer based on treatment results. To evaluate the possibility of predicting visual functions, data of patients with penetrating injuries who underwent surgical interventions at both the NMMCC "MMCH" and previous stages were analyzed. The OTS (Ocular Trauma Score) scale proposed by Kuhn and colleagues (Table 1) was used for analysis. The OTS scale allows for the prediction of probable visual acuity after 6 months, taking into account the visual acuity upon examination after the injury and the nature of the visual organ damage (Table 2).

During the 6-month follow-up period, 40 eyes (48%) were monitored (Table 3).

According to our data, during the initial examination the patients were distributed as follows based on the OTS scale for visual acuity: blindness - 27.5%, light perception/ movement of hand - 42.5%, 0.005 to 0.1 - 15%, 0.1 to 0.4 - 7.5%, 0.5 and above - 7.5%. Low vision is most commonly caused by various degrees of hemorrhage in the eye, retinal detachment, ruptures in the vascular membrane, suprachoroidal hemorrhages, and optic nerve damage.

Some patients did not receive further treatment due to sufficiently high visual function, while others continued treatment in other medical facilities, and some were discharged from the armed forces. According to the results of follow-up examinations within the specified period, the following results were obtained: blindness - 30%, light perception/movement of hand - 15%, 0.005 to 0.1 - 10%, 0.1 to 0.4 - 22.5%, 0.5 and above - 22.5%.

When comparing the results of treatment with the results predicted by the OTS scale, a high correspondence of the prognosis to the expected results of treatment is noted: in the case of blindness, almost all patients remain blind in the injured eye after six months. In the group with light projection and movement of the hand near the face, an improvement in visual function in most cases (65%) was noted, while, according to the OTS scale, these patients in most cases remain in this group or move to the group with blindness. Cases with visual acuity of 0.005-0.1 improve visual acuity after 6 months with the transition in most cases to 0.1 and above. The same trend, but, as expected, with a higher probability in groups 0.1-0.4 and above 0.5.

Table 1. Calculation of points Ocular Trauma Score (OTS)

Points summary OTS	Blindness	Light perception/ hand movement	from 0.005 to 0.1	from 0.1 to 0.4	from 0.5 and above
0-44	73%	17%	7%	2%	1%
45-65	28%	26%	18%	14%	15%
66-80	2%	11%	15%	28%	44%
81-91	1%	2%	2%	21%	74%
92-100	0%	1%	2%	5%	92%

Table 2. Estimated probability of visual acuity after 6 months

Vision acuity upon admission	Points	Type of injury	Points
blindness	60	Rupture	- 23
light perception / movement of hand	70	Endophthalmitis	- 17
0.005 to 0.1	80	Through-and-through wound	- 14
0.1 to 0.4	90	Retina detachment	- 11
0.5 and above	100	Afferent pupilary defect	- 10

Table 3. Distribution of the injured by groups at the initial examination and after 6 months

	blindness	light perception / movement of hand	0.005 to 0.1	0.1 to 0.4	0.5 and above
Primary visual acuity	27,5%	42,5%	15%	7,5%	7,5%
Visual acuity 6 months later	30%	15%	10%	20%	25%

Discussion

Overall, the results of the treatment of patients with combat-related ocular injuries in our clinic in 2014-2015 correspond to the calculated probability of preservation of visual function according to the OTS scale. However, it should be noted that the OTS scale was developed and is used to forecast the preservation of visual function in eye injuries during peacetime. On the other hand, combat trauma has significant differences such as frequent combined injuries to the eyes and other organs, systems that determine the severity of the patient's condition and the intensity of the immune reactions of the body, the inability to objectively assess visual acuity in unconscious patients, the distance of the site of injury from the medical institution where specialized ophthalmic care is provided, thus creating conditions for delaying the provision of specialized care, and the inability to position the patient after vitreoretinal surgeries with endotamponades, which affects the effectiveness of surgical treatment.

Taking into account the analysis data, the peculiarities of examination and treatment process of patients with combat-related ocular injuries, we believe it is possible to use the OTS scale to predict visual function in patients with eye injuries. At the same time, further refinement of the scale and the use of additional data, such as time intervals before performing surgical interventions, the severity of proliferative vitreoretinopathy (PVR), the presence and size of intraocular foreign bodies, etc., is promising and requires further study.

Conclusions

1. Considering the large number of patients with severe eye injuries during the russian war on Ukraine, scientific studies on the introduction of a system for predicting long-term functional results of optical analyzer combat trauma treatment into clinical practice, based on clinical data during the initial examination, remain relevant.

2. The results obtained when applying the OTS (Ocular Trauma Score) rating scale in most cases correspond to the results of the treatment of injured patients in the Ophthalmology Clinic of the NMMCC "MMCH" in 2014-2015.

3. Refinement of the existing OTS (Ocular Trauma Score) system and its adaptation to domestic conditions and realities of providing ophthalmic care for combat trauma of the visual analyzer is promising for further study.

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Disclosures

Received 31.03.2023

Accepted 09.06.2023

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Author contributions. *All authors participated in the collection of data, analysis of results, and drafting of the manuscript and approved the final version of the manuscript.*

Conflict of interest. *The authors declare no conflicts of interest that could influence their opinions on the subject matter or materials described and discussed in this manuscript.*