

Features of Combat-related Ocular Trauma in the Context of Modern Warfare

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Abstract:

Introduction: The incidence of eye trauma during armed conflicts varies from 0.5 to 13.0%. Evolution in warfare tactics has led to anti-personnel mines and various explosive devices, both improvised and manufactured, becoming the main causes of eye combat trauma in all military conflicts. The aim of the work was to analyse the features of providing ophthalmological care for combat injuries in modern military operations.

Material and methods: A retrospective analysis of the medical records of patients with combat eye injuries who underwent examination and treatment in our clinic from 2014 to 2024 was conducted. During the anti-terrorist operation in 2014–2021, we provided inpatient care to 1155 victims and performed 470 surgical interventions, which comprised 40% of all treated. A total of 530 patients with combat trauma received outpatient care. Since February 2022, in total 8300 patients with eye injuries have been treated in the hospital, 54% of whom required surgical intervention; more than 15,000 victims were consulted. **Results.** A comparative analysis shows an increase in the severity of injuries since 2022, i.e. since the beginning of full-scale war; first of all, a high rate of combined eye damage with other organs and systems, and an increase in the number of binocular injuries - from 34% in 2014–2021 to 64% in a later period. The frequency of severe and very severe injuries in 2014–2021 was 55%, and starting from 2022 – it was – 67%; in 13% of cases, the injury ended in complete destruction of the eye. The main causes of combat eye injuries were damage by shrapnel, debris, and gunpowder gases that fly apart as a result of an explosion. In the structure of penetrating wounds, the most common cases were cases with multiple intraocular foreign bodies (54%), also in eyes with penetrating wounds there were traumatic cataracts of varying severity (47%), hemophthalmos (26%), retinal detachment (20%), prolapse of the inner membranes of the eye (9%), endophthalmitis (6%), and foreign bodies of the deep layers of the cornea (20%). Among surgical interventions in 2014–2021, primary surgical treatment of penetrating wounds (35%), and combined interventions and vitreoretinal surgery (23%) prevailed. In 2022–2024, primary surgical treatment of penetrating wounds in the structure of surgical interventions accounted for 28%, and combined interventions and vitreoretinal surgery 34%. **Conclusions:** polymorphism of pathological changes in combat eye injuries and their combination with changes in other organs and structures necessitate an individual approach to the type and scope of surgical intervention. Providing assistance to such patients often requires the surgeon to be ready to perform a variety of surgical treatments and make adjustments to the scope of intervention directly during the operation, which is possible only in a highly specialised medical institution.

Key words:

eye injury, military trauma.

Introduction

Eye injuries represent a significant social issue because they are a major cause of unilateral blindness among working-age individuals. The proportion of ocular injuries within the general structure of traumatic injuries ranges from 2% to 15%, depending on the social, demographic, and cultural factors of each region [1]. The incidence of ocular trauma during armed conflicts varies between 0.5% and 13.0%. The evolution of warfare tactics has led to anti-personnel mines and various explosive devices—both improvised and industrially manufactured—becoming the leading causes of combat-related eye injuries in all military conflicts. Additional causes include firearm wounds and accidents [2, 3].

The purpose of this study was to analyse the specific features of ophthalmologic care for combat-related injuries under the conditions of modern military operations.

Material and methods

We retrospectively analysed the medical records of patients with combat-related ocular trauma who underwent examination and treatment at the Dnipropetrovsk Regional Clinical Ophthalmologic Hospital (DRCOH) from 2014 to 2024.

Since 2014, DRCOH has provided highly specialised ophthalmologic care to wounded military personnel and civilians. During the Anti-Terrorist Operation (ATO) from 2014 to 2021, a total of

1155 patients received inpatient care, and 470 surgical procedures were performed, accounting for approximately 40% of all treated cases. Seventy-seven surgeries were conducted at the Mechnikov Dnipropetrovsk Regional Hospital due to the critical condition of non-transportable patients. Another 530 patients received outpatient care at DRCOH's consultation polyclinic.

Since the start of full-scale military action in 2022, the number of patients with combat-related ocular trauma has significantly increased due to both a greater number of civilian casualties and the widespread use of mass-destructive weapons, leading to blast-related injuries. From February 2022 onward, 8300 patients were treated at DRCOH, 54% of whom required surgical intervention. In total, over 3 years of war, more than 15,000 individuals received consultations.

According to DRCOH's data, the proportion of eye injuries among all war-related trauma is 10.4%, which corresponds to literature estimates for ocular trauma during wartime [3].

Results

A comparative analysis of care provided to military personnel and civilians at DRCOH shows an increase in trauma severity since 2022, coinciding with the start of full-scale war.

A high rate of combined injuries involving the eyes and other organs/systems (primarily ENT and CNS) was observed: 78.8%

during 2014–2021, and 83.4% from 2022 onward. This necessitates a multidisciplinary treatment approach. The increase in blast injuries since the war escalation has led to a near-doubling in binocular trauma—from 34% in 2014–2021 to 64% in 2022–2024. Severe and very severe injuries accounted for 55% in 2014–2021, rising to 67% from 2022. About 50% of patients require prolonged multi-stage rehabilitation, and in 13% of cases, injuries result in complete destruction of the eye.

The main causes of most ocular combat injuries included shrapnel, debris, and explosive gases dispersed during blasts, as well as gunshot wounds causing massive ocular damage.

The structure of combat injuries for the period 2014–2021 and 2022–2024 is shown in Fig. 1, from which it follows that during the ATO period, isolated eye wounds were the most common, accounting for half of all injuries. With the onset of full-scale military operations, despite the increase in the total number of injuries, the proportion of isolated wounds decreased, while the number of moderate and severe contusions and combined injuries increased. In the structure of penetrating wounds, the most common cases were cases with multiple intraocular foreign bodies (54%); also in eyes with penetrating wounds there were traumatic cataracts of varying severity (47%), hemophthalmos (26%), retinal detachment (20%), prolapse of the inner membranes of the eye (9%), endophthalmitis (6%), and foreign bodies of the deep layers of the cornea (20%).

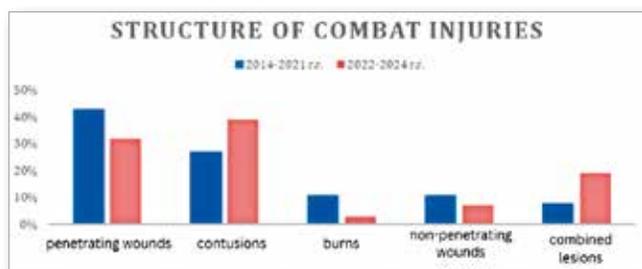


Fig. 1. Structure of combat injuries for the periods 2014–2021 and 2022–2024.

Figure 2 shows the structure of surgical interventions performed in our clinic on patients with combat injuries in different time periods. Among surgical interventions in 2014–2021, primary surgical treatment of penetrating wounds (35%), and combined interventions and vitreoretinal surgery (23%) prevailed. In 2022–2024, primary surgical treatment of penetrating wounds accounted for 28% of the structure of surgical interventions, and combined interventions and vitreoretinal surgery accounted for 34%.

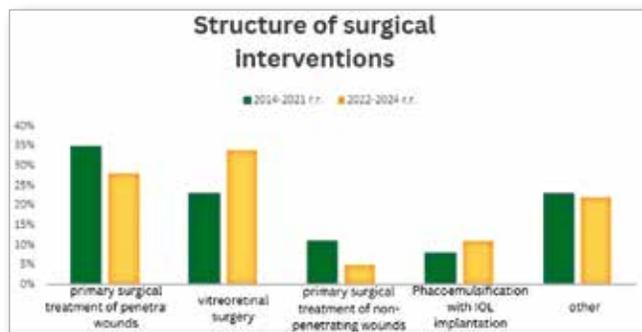


Fig. 2. Structure of surgical interventions for the periods 2014–2021 and 2022–2024.

Discussion

If we compare the structure of domestic and military injuries treated in hospital at the DRCOH hospital since 2022, we notice the significant severity of military injuries and a higher frequency of bilateral injuries. Thus, patients with domestic injuries pre-

dominantly had a mild degree of damage to the organ of vision (57%), moderate damage was present in 29%, and severe injuries were present in 14% of patients, while in military injuries there were no mild cases, 33% of patients had moderate damage, 60% had severe damage, and 7% had very severe damage. Bilateral damage in domestic injuries was less than 10% and was most often observed with burns of the eye and its appendages, while in military injuries this figure was 67%. In addition, especially at the beginning of a full-scale war, late hospitalisation of victims was observed – from 2 to 13 days after the injury, which is explained by the difficulties of evacuation from the combat zone, as well as the presence of severe concomitant pathology requiring priority treatment of patients in a multidisciplinary hospital. The most common concomitant pathology was facial bone fractures (11%), limb injuries (19%), inflamed wounds of the soft tissues of the face (31%), and open and closed craniocerebral trauma (28%). At the same time, the relatively low frequency of endophthalmitis is explained, firstly, by the high temperature of the wounding projectile, and secondly, by the intensive systemic antibacterial therapy that patients received due to their general somatic condition. The passage of a foreign body through all the membranes of the eye is often accompanied by massive damage to the anterior and posterior segments of the eye with or without tissue deficiency; intraocular haemorrhage, retinal detachment, choroidal rupture, optic nerve dissection, and orbital bone fractures, and it is characterised by significant polymorphism of clinical manifestations. Currently, the principle of one-stage comprehensive surgical treatment of penetrating wounds of the eyeball is generally accepted, which implies not only wound suturing, defect plastic surgery, but also the formation of the anterior chamber, repositioning and plastic surgery of the iris if it is damaged, and phacovitrophagy if the lens and vitreous body are destroyed.

The combination and polymorphism of post-traumatic changes in the anterior and posterior segments of the eye, as well as its appendages, significantly complicate the implementation of optical reconstructive surgeries aimed at restoring normal anatomical and topographic relationships; however, one-stage surgical correction of several pathologically altered structures of the eye provides the most complete and effective medical and social rehabilitation of patients. Considering that the vast majority of those injured in war trauma are people of working age, it is extremely important to restore visual functions and the anatomical structure of the eye for the most complete medical and social rehabilitation, which necessitates the use of advanced surgical technologies. As an example of the importance of timely provision of ophthalmological care to patients with war eye trauma in a specialised clinic to preserve visual functions, we will cite several clinical cases from our own practice.

Clinical case 1

Patient, aged 7 years, was admitted to the children's department of the KP "DOKOL" on the 11th day after receiving a mine-explosive injury. During this time, she was treated in a multidisciplinary children's hospital for a ruptured lung, an open wound of the anterior chest wall, a rib fracture, a condition after tracheostomy, acute respiratory failure type II, and cerebral oedema.

Upon admission to the DOKOL Clinical Hospital, visual acuity could not be checked due to the child's serious condition. OD – the eye is irritated, there is an adapted scleral wound at 12 o'clock; the cornea is transparent, spherical; the anterior chamber is of medium depth, the humour is transparent. There is subatrophy in the iris, posterior synechiae, diffuse opacity in the lens, rupture of the anterior capsule (Fig. 3). According to B-scan data, there is hyperechoic content in the lower section. OS – the eye is clinically healthy. Diagnosis: penetrating scleral wound with intraocular IT, traumatic cataract, hemophthalmos of the right eye.



Fig. 3. Patient's eye condition upon admission.

The first stage was the removal of the traumatic cataract with implantation of the CLARE+27.0D IOL into the capsular bag. The next stage included vitrectomy with removal of the posterior hyaloid membrane and removal of the intraocular IT, under which a perforated retinal defect was found. Subretinal fluid was removed, laser photocoagulation of the retina was performed using a laser probe, as well as tamponade of the vitreous cavity with silicone oil. Due to the severe general condition, the child was returned to a multidisciplinary children's hospital for follow-up treatment on the same day. Three months after the operation, after the patient's general condition had normalised, the silicone oil was removed. During a routine examination at the DOKOL outpatient clinic: corrected visual acuity OD = 0.8; OS = 1.0; IOP OD 15 mmHg, OS 17 mmHg. B-scan: no pathological echo signs. Right eye: adnexa without pathology, anterior chamber of medium depth, subatrophy in the iris, IOL is centred. Fundus: optic disc is pale pink, borders are clear; reflexes are preserved in the macular zone, on the periphery in the lower section there is a gap, delimited by coagulates. According to the Paediatric Ocular Trauma Score, the probability of obtaining high visual acuity in this case was approximately 1% [4]. The technical possibility of simultaneously performing various types of surgical intervention and changing tactics directly during the operation made it possible to achieve a good result even with severe trauma.

Clinical case 2

Serviceman, 32 years old, diagnosis: thermal burn of the conjunctiva, eyelids, and cornea of both eyes; thermal burn of 30% of the body surface (Fig. 4).



Fig. 4. Patient, thermal burn of the conjunctiva, eyelids, and cornea of both eyes; thermal burn of 30% of the body surface.

He was treated at the Dnipro burn centre, where he was under constant observation of an ophthalmologist and received antibacterial, anti-inflammatory, and reparative therapy. To correct lagophthalmos, the patient underwent plastic surgery of the upper and lower eyelids of both eyes.

After it became possible to transfer him to the DOKOL Clinical Hospital, the patient underwent penetrating keratoplasty using a keratobioimplant and femtosecond laser support on the right, worse eye. Eleven months after the penetrating keratoplasty, vis OD = 0.4, n/c, vis OS = 0.1, n/c (Fig. 5).



Fig. 5. The same patient after the treatment.

Conclusions

The polymorphism of pathological changes in combat eye injuries and their combination with changes in other organs and structures necessitate an individual approach to the type and scope of surgical intervention. Providing assistance to such patients often requires the surgeon to be ready to perform a variety of surgical treatments and make adjustments to the scope of intervention directly during the operation, which is possible only in a highly specialised medical institution. The use of modern surgical equipment allows for good functional results in the postoperative period even in individuals with severe and very severe eye injuries.

Disclosure

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