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Corneal Penetrating Injury Following Combat-Related Trauma – A Clinical Case Report

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Abstract:

Introduction: Ocular trauma is a leading cause of unilateral blindness worldwide, with about 1.6 million people losing their vision annually. Despite the small surface area of the eye, the risk of injury during armed conflicts is disproportionately high. Corneal damage often results in loss of transparency and scarring, leading to permanent vision impairment. These consequences place a significant burden on healthcare systems and highlight the urgent need for improved preventive and therapeutic approaches.

Case report: A 45-year-old male military patient was presented to the University Clinic with a corneal penetration injury with an intraocular foreign body, acute barotrauma, and a foreign body in the submandibular region. The patient's visual acuity was light perception in the right eye. Multiple foreign bodies in the neck and acute barotrauma were also noted during the examination. Biomicroscopic examination revealed a penetrating corneal wound and traumatic cataract of the right eye.

Conclusions: The two-stage therapeutic protocol ensured effective primary wound management and facilitated subsequent visual rehabilitation through delayed reconstructive surgery. Extended pharmacological treatment with cyanocobalamin demonstrated a reduction in corneal scarring and opacity, while also supporting partial restoration of corneal innervation.

Key words: corneal injury, anterior segment optical coherence tomography (AS-OCT), opacity, treatment.

Ocular trauma is the leading cause of unilateral blindness worldwide. Every year, 1.6 million people lose their vision as a result of ocular trauma. Although the eye represents only 0.1% of the body's anterior surface, the risk of injury during war is estimated to be 20–50 times higher than expected, and in armed conflicts, eye injuries account for a significant proportion of battlefield injuries [1, 2].

One of the consequences of any process in the cornea (traumatic, inflammatory, postoperative) is a violation of the transparency of the cornea, which leads to a significant reduction or loss of vision. The study of the opportunities for corneal structure restoration remains relevant and is supplemented by new facts [3]. In cases of damage to the superficial layers of the cornea, epithelialisation occurs with the repair of the morphological structure and function of the eye. Pathological regeneration occurs in cases of damage to the deep layers, which manifests in persistent changes in the morphological structure of the cornea in the form of opacity and fibrosis [4].

A significant proportion of eye injuries lead to permanent vision loss, despite the possibility of surgical and medical treatment. Thus, the impact of corneal injuries goes far beyond individual disability, creating long-term challenges for health care systems and requiring the development of new and improved preventive and therapeutic strategies [5].

Methods

The purpose of this study was to examine a clinical case of corneal damage and analyse the possibilities for its regeneration. A 45-year-old patient was diagnosed with an eye injury resulting from a combat wound caused by an explosive device.

Results

A 45-year-old male military patient presented to the University Clinic with corneal penetration injury with an intraocular foreign body, acute barotrauma, and a foreign body in the submandibular region.

The patient's visual acuity was light perception in the right eye. Multiple foreign bodies in the neck and acute barotrauma were also noted during the examination. Biomicroscopic examination revealed a penetrating corneal wound and traumatic cataract of the right eye. Photophobia, blepharospasm, lacrimation, eye pain, and significant conjunctival irritation were present. The ultrasound examination showed that the optical section of the retina and the posterior segment of the eye were normal. The integrated score was 0.81 [6]. The integral score for corneal diseases was calculated using the following formula:

$$W = \frac{12S}{N^2(n^3 - n)}$$

W – coefficient of severity of corneal damage symptoms;
S – sum of squared deviations;
N – number of patients;
n – number of signs

The first stage of treatment involved examining the corneal wound, removing the intraocular foreign body, and suturing the wound. In follow-up treatment and observation, the traumatic cataract progressed, intraocular pressure (IOP) rose to 30 mmHg, and the ciliary reaction and corneal irritation syndrome increased.

The second stage of treatment involved cataract surgery with intraocular lens (IOL) implantation. During the surgery, the lens of the right eye was removed, anterior vitrectomy was performed, and the posterior synechia between the iris and the lens was removed, forming an irregularly shaped pupil. After the operation, visual acuity was 0.1. The ciliary reaction, lacrimation, photophobia, corneal opacity in the area of the wound, and stromal opacity decreased, and the anterior chamber was deep and transparent.

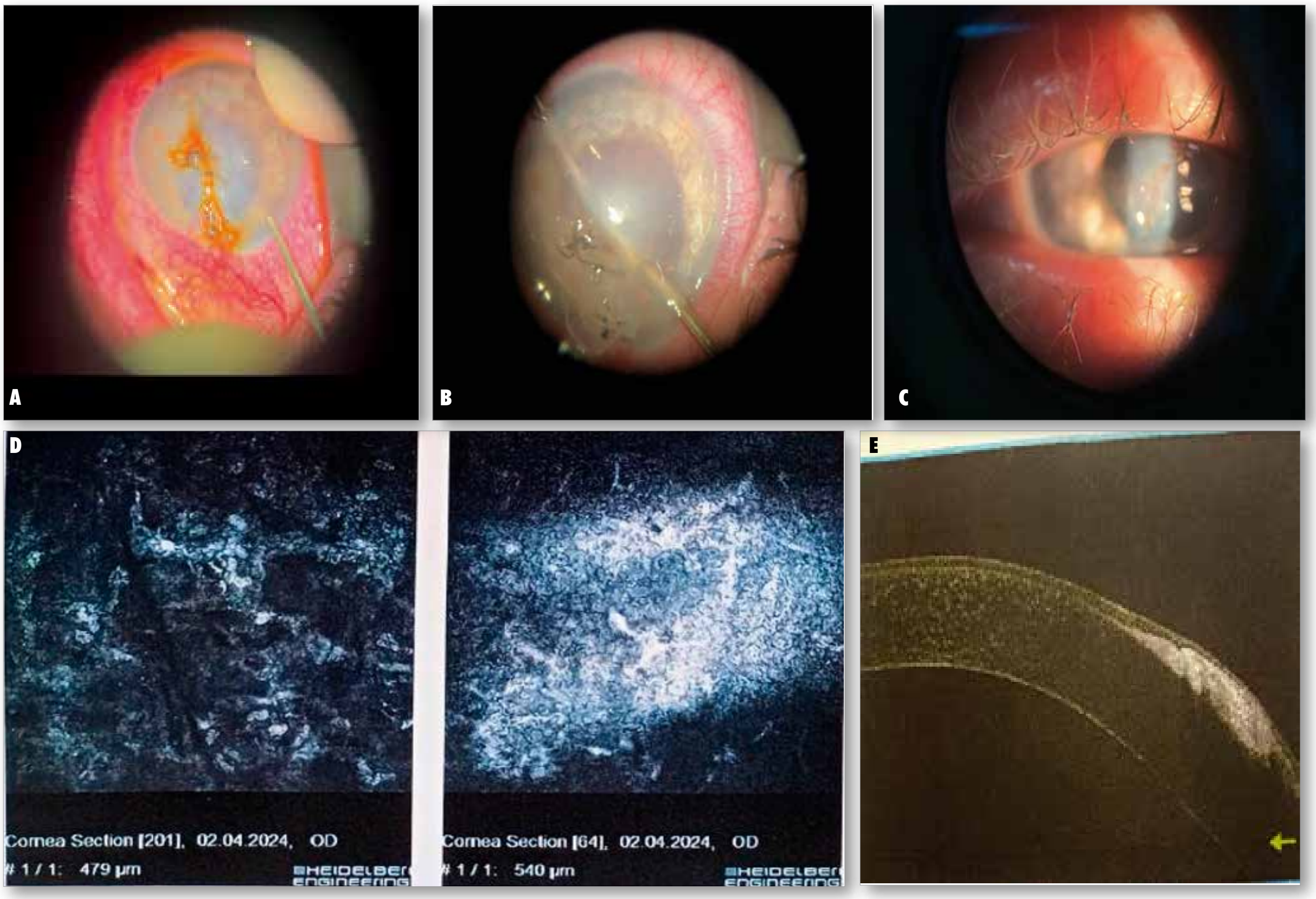

Fig. 1. A – Stage I of treatment; B – FEK and IOL implantation; C – one month after surgery; D – KMS, presence of keratocytes with altered configuration; E – OCT signs of opacity, corneal scarring.

Following one month of treatment, visual acuity was 0.4, corneal scarring and the area of opacity were reduced, there was no neovascularisation, the anterior chamber was of medium depth, there was no ciliary pain, and the pupil was irregular in shape (Fig. 1). On examination of the fundus, the optic disc was pale pink with clear borders, and the retina was intact. The injury to both eyes was classified as a near eye injury according to the Birmingham Eye Trauma Terminology (BETT). The integrated score was 0.28.

Medical treatment included antibiotics, corticosteroids, and nonsteroidal anti-inflammatory drugs for topical administration. Also, systemic antibacterial, antifungal, and anti-inflammatory therapy was prescribed. Keratoprosthetics (dexpanthenol) and antibiotic ointments were additionally used in the healing of corneal sutures. For a month, hyaluronic acid eye drops with vitamin B12 were also used 4 times a day. Additional examination methods included the following: fluorescein test, anterior segment optical coherence tomography (AS-OCT), ultrasound, corneal sensitivity test, confocal microscopy, electrophysiology, and visual fields at all stages of treatment.

According to AS-OCT examination, the corneal thickness in the scar area was increased to 622 µm, and corneal oedema was detected. After reconstructive surgery, changes in the structure of the cornea were also determined. The cornea in the scar formation area was visualised with hyper-refractive thickening, while the opacity area decreased and the corneal thickness was 545 µm. Against the background of general hyper-reflexivity of the cornea, hyporeflective areas were also detected, which biomicroscopically corresponded to the scar area in the depth of the stroma (Fig. 1E).

Confocal microscopy of the cornea, taken near the defect, shows hyperreflective, dotted, rounded inclusions against a background of polymorphically altered keratocytes and epithelial cells, in the subepithelial layers – hyperreflective load, sub-basal nerve plexus – nerve fibres not detected in the area of injury (D), general reflection is determined in the stroma. After treatment, thinned nerve fibres, tortuous, atypical nerve fibres were determined in the periphery, which are visualised in the cornea after treatment, a significant number of dendrites (inflammatory cells of Langerhans) are determined in the area of opacity and injury (Fig. 1D).

Discussion

The severity of injuries in combat zones often leads to permanent vision loss and high levels of disability among victims. The rehabilitation process is long and complex, requiring timely repeat surgical interventions, prevention of infections, and treatment of other injuries. Therefore, such injuries need new approaches to treatment and visual function rehabilitation, especially considering corneal trauma [1, 7].

This clinical case demonstrates the diagnostic capabilities for assessing the condition of the cornea after trauma. Biomicroscopic examination allows for the assessment of morphological changes, the scar area, wound healing, and the depth of the anterior chamber. It also allows for the assessment of the condition of the lens, which became cloudy as a result of trauma, as well as deformation of the iris and pupil. The assessment of ophthalmic symptoms is quantified through integral indicators that change during treatment and recovery. AS-OCT data show the thickness of the cornea and hyper-reflective areas of the stroma, as well as assess the scar's shape and area. Corneal opacity caused by trauma is characterised by clearly defined edges with epithelial defects [8]. Confocal microscopy allows the microstructure of the cornea to be obtained, including the condition of the epithelium, keratocytes, and endothelium, which is important in assessing the innervation of the cornea, detecting inflammatory Langerhans cells, destruction of the stroma, and then its regeneration [9].

Thus, the study of clinical cases of eye trauma is a promising modern direction in understanding and predicting the course of trauma and the possibilities for its recovery [10].

The two-stage therapeutic approach first allowed for primary surgical management of the injury, thereby preventing wound infection. Subsequently, reconstructive surgery was undertaken to restore vision during a later period, when reparative processes and inflammatory activity had diminished. Extended pharmacological therapy contributed to the reduction of corneal scarring, decreased both the depth and extent of corneal opacity, and facilitated partial recovery of corneal innervation, attributable to the therapeutic action of cyanocobalamin.

Disclosure

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