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Surgical treatment of open globe trauma complicated with the presence of an intraocular foreign body

Leczenie operacyjne otwartych urazów gałki ocznej powikłanych obecnością ciał obcych wewnątrzgałkowych

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Abstract: Background: Open globe injuries complicated with the presence of an intraocular foreign body constitute a vision threatening condition.
Purpose: To present the results of pars plana vitrectomy in patients with intraocular foreign body.
Material and methods: Medical records of 22 patients were analyzed. Retrospective analysis of data included visual acuity, age, gender and type of injury.
Results: All patients were men and the mean age was 37 years. All injuries occurred while working with a hammer. All patients were treated with pars plana vitrectomy combined with intraocular foreign body removal and internal limiting membrane peeling. The visual acuities improved in 9 cases (41%), in 13 cases (59%) the deterioration of visual acuity was observed, no eye was enucleated. In 14 eyes pars plana vitrectomy was combined with lens removal, in 14 eyes silicone oil was used as a tamponade.
Conclusions: Surgical intervention with pars plana vitrectomy combined with intraocular foreign body removal and cataract extraction may preserve severely traumatized eyes and maintain or even improve vision.
Key words: ocular trauma, vitrectomy, intraocular foreign body.
Abstrakt: Wstęp: urazy gałki ocznej powikłane obecnością ciała obcego wewnątrzgałkowego często doprowadzają do utraty widzenia.
Cel pracy: przedstawienie wyników leczenia metodą witrektomii u pacjentów, którzy doznali urazów gałki ocznej wskutek wniknięcia ciała obcego do jej wnętrza.
Materiał i metody: badaniem objęto 22 pacjentów. Dokonano retrospektywnej analizy danych: ostrości wzroku, wieku, płci oraz przyczyn urazu.
Wyniki: w badaniu uczestniczyli tylko mężczyźni – średnia wieku 37 lat. Wszystkie urazy powstały podczas kucia młotkiem. U wszystkich chorych wykonano zabieg witrektomii połączony z usunięciem ciała obcego wewnątrzgałkowego oraz operacją zaćmy. U 9 badanych (41%) ostrość wzroku uległa poprawie, u 13 badanych (59%) pozostała niezmienna. U 14 pacjentów przeprowadzono zabieg łączony – witrektomię i usunięcie soczewki; w 14 oczach zastosowano tamponadę olejem silikonowym.
Wnioski: leczenie operacyjne obejmujące witrektomię połączoną z usunięciem ciała obcego wewnątrzgałkowego oraz operacją zaćmy może prowadzić do zachowania gałki ocznej, a także utrzymania widzenia, a nawet jego poprawy.
Słowa kluczowe: uraz oka, witrektomia, ciało obce wewnątrzgałkowe.

Introduction

Open globe injury is one of the most serious types of eye injury with poor prognosis concerning the visual function (1). Open globe laceration may be complicated by the presence of an intraocular foreign body (IOFB). IOFB may damage the following ocular structures: cornea, iris, lens, retina and choroid. Thus, IOFB may be found in the vitreous cavity, anterior chamber, retina, lens, or subretinal space (2). The IOFB entry

wound is a site of extrusion of ocular contents and a potential entrance for pathogens causing endophthalmitis. Apart from a direct destruction of ocular tissues and virulent consequences of infection, the metallic IOFB, even if sterile, may still be toxic. In the long-term, iron IOFB may cause eye siderosis, resulting in irreversible structural and functional damage to the retina (3).

All these factors make open globe injuries complicated with IOFB presence a vision threatening state, therefore they require immediate treatment. However, the IOFB removal is the most challenging of all ophthalmic procedures, as the surgeon may cause iatrogenic damage to eye structures.

The diagnosis of eye trauma with IOFB presence is based on medical history, ophthalmic examination and computed tomography (CT). Most typical circumstances of such injury include hammering, explosions, grass trimming and car accidents. CT of the eye and the orbit makes it possible to detect IOFB and differentiate whether it is metallic or non-metallic. It also allows assessment of its size and location within the eye.

In the past metallic IOFB were removed using the external electromagnet. However, this procedure was often complicated with retinal detachment and/or incarceration of eye tissues into a wound (4).

At present, the procedure of choice in cases with IOFB presence is pars plana vitrectomy (PPV). PPV with modern visualization and illumination systems as well as proper instrumentation reduces the risk of iatrogenic lesions. The application of long-term silicon oil tamponade protects the retina from re-detachment during scarring processes. When needed, PPV should be combined with cataract extraction.

The objective of this study was to analyze the visual outcomes in patients with IOFB who had been treated with PPV combined with cataract removal at a large referral center in south-eastern Poland.

Material and methods

Cases with IOFB in the posterior segment of the eye treated with PPV at the Department of General Ophthalmology, Medical University of Lublin, Poland were analyzed retrospectively. CT of the eye and the orbit was performed preoperatively in all patients, confirming the IOFB presence. Collected data included: age, gender, history of injury, involved ocular structures, signs of endophthalmitis, baseline and final visual acuity as well as the duration between the trauma and surgery. Patients with follow up time of less than one month and IOFB in the anterior chamber were not included in this study.

The best corrected visual acuity in the affected eye was measured using Snellen decimal scale. The study compared the initial and the final best-corrected visual acuity. One or more lines of improvement on Snellen visual acuity chart was considered as "improvement". After the 0.1 letter, counting fingers, hand motion, light perception, and no light perception were considered the next line on Snellen chart.

Results

22 cases treated between 2009 and 2013 were analyzed in the study. All patients were men at the mean age of 37 years (range: 15 to 63 years old). IOFBs were metallic and the eye injury was a result of hammering in all cases. The mean follow up time was 6.6 months (range: 32 days to 17 months). The average time interval between the trauma and initial surgery was 8.8 days (min: 0 days, max: 59 days, median: 1 day). All surgical procedures were performed under general anesthesia. The impact wound within the cornea was observed in 16 cases, within the sclera – in 6 cases; the lens was injured in 14 cases, retinal detachment was observed in 5 cases and endophthalmitis was diagnosed in 5 cases.

PPV with IOFB removal and wound closure was performed as an initial procedure in 19 cases. In 2 cases, PPV was followed by wound closure as the first procedure. The lens was removed by phacoemulsification in 14 cases, posterior intraocular lens was implanted in 8 cases. In 14 cases, silicon oil tamponade was used. It was subsequently removed in 9 cases. In 5 cases, silicon oil was present until the end of follow up period. The internal limiting membrane (ILM) was peeled within the macular area during PPV in all cases.

The mean best corrected visual acuity at baseline was 0.37 (from light perception to 1.0). The mean number of surgical procedures per patient was 1.7. The visual acuity improved in 9 cases (41%), whereas vision deterioration was observed in 13 cases (59%). At the end of the follow up period no light perception was observed in 3 eyes. No eye was enucleated as a primary or secondary procedure during the observation period.

Discussion

Ocular injuries constitute 1.97% to 6.00% of all trauma cases. The estimated annual incidence of open globe injuries ranges from 3 to 7 per 100000 eye injuries (5, 6). In the United States, eye injury is a leading cause of acquired monocular blindness (7). Open globe injuries, the most severe of eye trauma (1), are defined as the traumatic impairment of structural integrity of the eye wall. This structural impairment may be described as a rupture (following blunt eye injury) or laceration which refers to a penetrating injury by a sharp object (8). In 10% of cases, the open globe injury complicated with IOFB causes no light perception in the affected eye (9). Such eyes are enucleated due to blindness and pain in 4% of cases (10).

Accidents complicated with IOFB presence are most common among young males and they are mostly work-related with metal hammering or chiseling and trimming of grass being the typical circumstances (9, 11). Such data is also confirmed in present study, where all patients were males at the mean age of 37 years. Apparent differences in injury circumstances relative to demographic characteristics of patients with open-globe injury complicated with IOFB presence and blunt trauma were observed. In cases of blunt trauma caused by wood chopping, the mean age of patients was 64 and the male to female ratio was 3: 1 (12).

According to the Ocular Trauma Score, IOFB presence is a predictive factor for poor prognosis. Other factors indicative of poor visual results such as low initial visual acuity, endophthalmitis and retinal detachment are also present in IOFB cases (1). Endophthalmitis develops more often in cases with open globe injuries complicated with IOFB (especially originating from organic matter) and it has a more virulent course (13, 14). In our study, the incidence of endophthalmitis was 22%, which is significantly higher than in other studies, where

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it ranged from 7% (14) to 9% (9). The incidence of endophthalmitis also depends on environmental factors. In rural settings, it can reach up as high as to 30%, which may be explained by the common presence of causal micro-organisms in rural environment (15). The size and location of the entry wound is another important determinant of the final outcomes. In our study, the corneal wound was 2.5-fold more frequent than the scleral one, which corresponds with the results of other studies (16). The more common corneal location of the entry wound is explained by the mechanism of injury and ocular anatomy. It should be noted, however, that more posterior location of the scleral wound worsens the prognosis (9, 16, 17).

A corneal wound reduces corneal transparency and, consequently, hinders the surgical procedure. In the long term perspective, corneal scarring is a source of visual disturbances for patients. With anterior location of the wound, the risk of lens injury and development of traumatic cataract is higher; it can be observed in 63% of cases.

The above-mentioned factors implicate the strategy of surgical treatment of eyes with IOFB. The ultimate goal of the treatment is not only to remove the IOFB, but primarily to prevent the development of endophthalmitis and then to achieve maximum possible long-term visual outcomes by repairing all affected ocular structures. Apart from wound closure and IOFB removal, it often requires cataract extraction, intraocular lens implantation, corneal graft, iridoplasty, and retinal re-attachment or prevention of its detachment. These surgical interventions could be performed in different combinations. The actual treatment strategy depends on multiple factors, such as local (ophthalmic) and general (systemic) health status of the patient, healthcare staff skill level, available instruments and logistics.

IOFB can be removed as the primary procedure. The surgery of choice in IOFB located within the posterior segment of the eye is PPV. This procedure requires proper medical instrumentation and trained medical staff (retinal surgeon) experienced in the treatment of such challenging cases, which is available mostly in referral centers.

Treatment of eyes with IOFB injury requires several operations in most cases. Surgical wound closure (corneal or scleral) is performed in the majority of patients as the emergency primary globe repair, which protects the eye from developing endophthalmitis (14) and allows time to send the patient to a referral center (9). If no signs of infection are observed, the damage to the ocular structures is limited, and visual function is not significantly reduced, the eye can be monitored and the surgery, if needed, can be performed later as an elective procedure. This strategy, however, has some disadvantages, e.g. a higher number of operations, higher costs and a greater risk related to general anesthesia required for long ophthalmical procedures in young patients. Due to the risk of eye tissue extrusion, retro- or parabulbar anesthesia is contraindicated in open globe injuries. In our case series, 86% of PPV with IOFB removal was performed as a primary procedure and the mean number of procedures per patient was reduced to 1.7.

An opacified lens can be removed during cataract surgery, which can be performed in combination with PPV. Depending on the posttraumatic anatomical conditions, an artificial intraocular lens (IOL) can be implanted or the eye can be left aphakic. Primary IOL implantation is more beneficial for postoperative refraction and reduces the number of operations, but in some severely injured eyes, the anatomical relationships and intraocular bleeding make it infeasible. IOL can additionally increase the postoperative inflammation of the eye, which may in turn further impair the already poor visual acuity. In this study, all severely traumatized lenses were removed during PPV without IOL implantation. The subsequent implanting procedure was possible in only 10% of cases (18).

The retinal health is critical for visual function. As long as the retina remains intact, many injured eyes retain the potential for visual recovery. The timely re-attachment of a traumatically detached retina is crucial for the repair process (18). The retina can be attached with internal tamponade with expanding gas. After gas absorption the eye is refilled with physiological water produced by the cilliary body. No additional procedure is required. In trauma cases complicated with IOFB presence, the increased risk of tractional retinal re-detachment due to scaring processes referred to as proliferative vitreoretinopathy (PVR) is observed. It is caused by inflammatory mediators derived from the post-traumatic breakdown of the blood-retinal barrier. The risk factors include intraocular hemorrhage, extensive posterior segment involvement, retinal detachment and dispersion of retinal pigment epithelial cells, what acts as a stimulant for intraocular cellular proliferation and scarring (19). That is why the primary long-term silicone oil tamponade is recommended in such eyes. It minimizes the risk of tractional re-detachment during the period of the increased proliferative activity by means of reducing the circulating levels of growth factors and due to its hemostatic properties (19, 20). In present study, ILM peeling applied during PPV proved to be an effective prevention of of epiretinal membrane formation and retinal detachment due to PVR (21).

In tour study, the visual acuity improved only in 41% of cases. This result is similar to other studies (16). In complicated eye trauma the visual function is not the only important outcome. Taking into consideration the young age of patients, the preservation of patient's own eye and its appearance are of crucial importance. In this study, no eye was removed during the follow up time.

Conclusions

In cases with IOFB in the posterior segment of the eye, PPV intervention combined with silicon oil tamponade, ILM peeling and cataract extraction may maintain or even improve vision. Such treatment preserves the severely traumatized eyes, protecting them from atrophy and enucleation.

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