



Clinical characteristics of posterior segment penetrating eye injuries treated in tertiary referral hospital in Serbia

Kliničke karakteristike penetrantnih povreda zadnjeg segmenta oka lečenih u tercijarnoj zdravstvenoj ustanovi u Srbiji

Igor Kovačević*†, Aleksandra Radosavljević*†, Jelena Karadžić*†,
Ivan Stefanović*†, Jovana Vukadinović*

Clinical Center of Serbia, Hospital for Eye Diseases, *Department for Ocular Trauma and Vitreoretinal Surgery, Belgrade, Serbia; University of Belgrade, Faculty of Medicine, †Ophthalmology Department, Belgrade, Serbia

Abstract

Background/Aim. Ocular trauma is a significant cause of visual impairment worldwide. The aim of the study was to analyze clinical characteristics of patients with penetrating eye injuries with retained intraocular foreign body (IOFB) in posterior segment of the eye. **Methods.** The retrospective study enrolled medical records of consecutive patients hospitalized in a five year period (2012–2016) in a tertiary referral center in Serbia. Surgical repair included *pars plana* vitrectomy and IOFB removal. Postoperative results were evaluated using the best corrected visual acuity (BCVA). **Results.** Out of 130 patients who suffered penetrating eye injury with retained IOFB, 72 had IOFB in posterior segment of the eye (43 in retina, 25 in vitreous, 3 in ciliary body, 1 on the optic nerve). Patients were predominantly young adults (aged 44.3 ± 14.9 years, 97.2% men). Average BCVA at admission was poor (0.27 ± 0.38 , measured by Snellen chart), and 52.8% of patients had BCVA of counting fingers at 1 meter or less. The majority of patients had corneal wound (70.8%), medium sized IOFB (48.6%), iris injury

(61.1%) and traumatic cataract (69.4%). Complications included retinal detachment (16.7%) and endophthalmitis (15.3%). Two patients had the eye enucleated due to severe endophthalmitis, which could not be otherwise controlled. Significant risk factors for postoperative outcome were: initial BCVA ($p < 0.001$), ocular hypotony ($p = 0.013$), medium size of IOFB ($p = 0.037$), presence of traumatic cataract ($p = 0.036$), retinal detachment ($p = 0.032$) and endophthalmitis ($p = 0.045$). **Conclusion.** Treatment of posterior segment penetrating eye injuries remains a challenge due to high frequency of low initial visual acuity, retinal detachment and endophthalmitis, all of which are risk factors for poor visual outcome. Patients with better initial BCVA, normal intraocular pressure and small IOFB have better postoperative results.

Key words:

endophthalmitis; eye foreign bodies; eye injuries; retinal detachment; risk factors; treatment outcome.

Apstrakt

Uvod/Cilj. Trauma oka je značajan uzrok vidne nesposobnosti širom sveta. Cilj studije bio je da se ispituju kliničke karakteristike blesnika sa penetrantnim povredama oka i zadržanim stranim telom u zadnjem segmentu oka. **Metode.** U retrospektivnoj studiji analizirana je medicinska dokumentacija bolesnika uzastopno hospitalizovanih tokom petogodišnjeg perioda (2012–2016) u tercijarnom zdravstvenom centru u Srbiji. Hirurške procedure su obuhvatale *pars plana* vitrektomiju i uklanjanje stranog tela. Postoperativni rezultati su procenjivani pomoću najbolje korigovane vidne oštine. **Rezultati.** Od ukupno 130 bolesnika koji su pretrpeli penetrantnu povredu oka sa zadržanim intraokularnim stranim telom, njih 72 su imala strano telo zadržano u

zadnjem segmentu oka (43 na retini, 25 u staklenom telu, 3 u cilijarnom telu, 1 na vidnom živcu). Bolesnici su najčešće bili mlađe odrasle osobe muškog pola (prosečna starost $44,3 \pm 14,9$ godina, 97,2% muškarci). Prosečna vidna oštrina na prijemu bila je niska ($0,27 \pm 0,38$, mereno na Snellen optotipu), a čak 52,8% bolesnika imalo je vidnu oštrinu brojanje prstiju na 1 metar ili manju. Većina bolesnika je imala ranu lociranu na rožnjači (70,8%), intraokularno strano telo srednje veličine (48,6%), povredu dužice (61,1%) i traumatsku kataraktu (69,4%). Najznačajnije komplikacije bile su ablacija retine (16,7%) i endoftalmitis (15,3%). Dva bolesnika su morala da budu podvrgnuta enukleaciji oka zbog teškog endoftalmitisa koji nije mogao biti kontrolisan drugim metodama. Značajni prognostički faktori rizika od postoperativnog ishoda bili su vidna oštrina na prijemu

($p < 0,001$), prisustvo hipotonije oka ($p = 0,013$), strana tela srednje veličine ($p = 0,037$), prisustvo traumatske katarakte ($p = 0,036$), ablacija retine ($p = 0,032$) i endoftalmitis ($p = 0,045$). **Zaključak.** Lečenje penetrantnih povreda zadnjeg segmenta oka još uvek predstavlja izazov, zbog visoke učestalosti teških povreda sa niskom početnom vidnom oštrinom i komplikacijama poput ablacije retine i endoftalmitisa, koji svi predstavljaju faktore rizika od lošeg ishoda po vid. Bolesnici sa boljom vidnom oštrinom na pri-

jemu, normalnim vrednostima intraokularnog pritiska i malim intraokularnim stranim telima imaju najbolje postoperativne rezultate.

Ključne reči:

endoftalmitis; oko, strana tela; oko, povrede; retina, ablacija; faktori rizika; lečenje, ishod.

Introduction

Ocular trauma still remains significant cause of visual impairment, particularly in developing countries¹. Mechanical injuries of the eye are classified into open and closed depending on the integrity of the wall of an eye. Penetrating injuries are subcategory of open globe injuries, defined as full thickness defects of an eye wall, usually caused by a sharp object. Sometimes, the object that caused the injury is retained within the eye as intraocular foreign body (IOFB)². The initial type and extent of injury are decisive for the final outcome. Severity of the injury can vary greatly, and is generally accepted that visual acuity at presentation, the zone of eye injury, presence of ocular hypotony, retinal detachment, posttraumatic endophthalmitis and afferent pupillary defect are the most significant factors influencing the postoperative visual acuity^{3,4}. The aim of primary surgical repair is to restore the integrity of the globe and to prevent vision threatening complications. Timing of surgery is essential, since early repair can impede complications such as endophthalmitis, retinal detachment, proliferative vitreoretinopathy, IOFB associated metallosis and sympathetic ophthalmia^{5,6}.

Patients with penetrating eye injuries and retained IOFB in the posterior segment of the eye remain the most difficult cases for surgical repair. The postoperative visual recovery is often not complete. The aim of this study was to analyze clinical characteristics and visual outcome in a group of patients with this type of injury, as well as clinical parameters that are important for prognosis and postoperative outcome.

Methods

The retrospective study included consecutive patients, hospitalized for penetrating eye injury between January 1, 2012, and December 31, 2016. All patients underwent primary surgical repair according to the standardized protocol, at the Department for Traumatology and Vitreoretinal Surgery of the Hospital for Eye Diseases in Belgrade, which is the tertiary referral center in Serbia. At admission, patients were fully assessed including medical history, best corrected visual acuity (BCVA), measured by Snellen chart at 6 m and converted to decimal notation, applanation tonometry (when appropriate/possible), slit lamp examination, indirect ophthalmoscopy with 90D and 20D lens and ultrasound examination. Furthermore, patients with

suspect metal foreign bodies had undergone orbital radiography. All patients had surgical repair, that included pars plana vitrectomy (PPV) and IOFB removal, performed according to the standardized protocol, within the first 12 hours from the admission⁷. Cataract extraction, endolaser or cryopexy were performed as needed. Postoperative results were evaluated using BCVA at the discharge from the hospital. Furthermore, in patients who had postoperative complications that required additional hospitalizations, all were analyzed and shown in the results.

The study has followed the tenets of the Declaration of Helsinki, and was approved by the Ethics Committee of the Clinical Center of Serbia.

Data were analyzed using SPSS 15.0. Methods used included Student's *t*-test or Wilcoxon test for comparison of numerical variables, χ^2 or Mann-Whitney U test for categorical variables (as appropriate). Correlation analysis included Pearson's correlation for numerical variables and Spearman's correlation for categorical variables (as appropriate). The level of statistical significance was 0.05.

Results

During the study period, a total of 130 patients with penetrating eye trauma with retained IOFB were hospitalized. Out of them, 13 had an old injury that lasted more than 10 days and 45 had IOFB retained in the anterior segment of the eye and were excluded from the study. Totally, 72 patients had IOFB in the posterior segment of the eye and were further analyzed. The vast majority of patients were men (70 patients, 97.2%) and 84.7% of the patients of both sexes belonged to working population (average age 44.3 ± 14.9 , range 12–82 years). Detailed clinical characteristics of patients are shown in Table 1.

Postoperative results of IOFB removal and wound repair are shown in Table 2. Majority of patients had pars plana vitrectomy with instillation of silicon oil and phacoemulsification (63.9%). IOFB was completely removed in 87.5% of the cases. The remaining 12.5% had an IOFB positioned in such place (for example, within the globe wall) that it was not possible to remove it without significant damage to the eyeball. Postoperative BCVA was significantly better ($p = 0.046$, data not show in Table 2) and the majority of patients had normal IOP (76.4%). Secondary glaucoma was present in 13.9% of the patients, and in all cases IOP control could be achieved with conservative treatment. Average number of hospitalizations was 1.5 ± 1.1 ,

Table 1
Clinical characteristics of patients with posterior segment penetrating trauma and retained intraocular foreign body (IOFB)

Variable	Values
Sex	
male	70 (97.2)
female	2 (2.8)
Age (years)	44.3 ± 14.9; 12–82
11–20	2 (2.8)
21–30	12 (16.7)
31–40	13 (18.0)
41–50	21 (29.2)
51–60	15 (20.8)
61–70	6 (8.3)
71–80	2 (2.8)
81–90	1 (1.4)
Affected eye (side)	
right	30 (41.7)
left	40 (55.5)
both	2 (2.8)
Time lapse between injury and hospital admission (days)	1.7 ± 2.6; 0–10
0–1	49 (68.1)
2–4	13 (18.0)
5–10	10 (13.9)
BCVA at admission	0.27 ± 0.38; amaurosis - 1.0
0.7–1.0	17 (23.7)
0.4–0.6	5 (6.9)
0.2–0.3	5 (6.9)
0.05–0.1	5 (6.9)
0.02–0.04	2 (2.8)
< 0.02 or light perception	36 (50.0)
no light perception	2 (2.8)
IOP at admission (mm Hg)	13.3 ± 6.4; 5–44
Localization of the wound	
cornea	51 (70.8)
sclera	20 (27.8)
both	1 (1.4)
Localization of the IOFB	
in vitreous cavity	25 (34.7)
in the ciliary body	3 (4.2)
on the retina	43 (59.7)
on the optic nerve	1 (1.4)
Size of the IOFB (mm)	3.6 ± 2.2; 1–11
small (< 2)	19 (26.4)
medium (3–5)	35 (48.6)
big (> 5)	10 (13.9)
not known	8 (11.1)
Injury of the iris	
absent	28 (38.9)
present	44 (61.1)
Lens status	
transparent	22 (30.6)
traumatic cataract	50 (69.4)
Retinal detachment	
absent	60 (83.3)
present	12 (16.7)
Endophthalmitis	
absent	61 (84.7)
present	11 (15.3)

Note: The values are given as mean ± standard deviation; range (minimum-maximum) or number (percentage) of patients.

BCVA – best corrected visual acuity; **IOP** – intraocular pressure.

Table 2
Postoperative results of intraocular foreign body (IOFB) removal and surgical repair of the wound

Variable	Values
IOFB removal	
PPV with SO	12 (16.7)
PPV with SO and CE	46 (63.9)
removal with electromagnet	14 (19.4)
IOFB surgery outcome	
IOFB removed	63 (87.5)
IOFB not completely removed	9 (12.5)
BCVA at discharge	0.34 ± 0.38; amaurosis – 1.0
0.7–1.0	17 (23.6)
0.4–0.6	10 (13.9)
0.2–0.3	9 (12.5)
0.05–0.1	10(13.9)
0.02–0.04	1 (1.4)
< 0.02 or light perception	20 (27.8)
no light perception	5 (6.9)
IOP at discharge	15.0 ± 5.5; 3–34
normotensive	55 (76.4)
hypotensive	7 (9.7)
secondary glaucoma	10 (13.9)
Number of hospitalizations	1.5 ± 1.1
1	50 (69.4)
2	14 (19.4)
3	3 (4.2)
4	3 (4.2)
5 or more	2 (2.8)

Note: The values are given as mean ± standard deviation; range (minimum-maximum) or number (percentage) of patients.

PPV – pars plana vitrectomy; **SO** – silicon oil; **CE** – cataract extraction (phacoemulsification or lensectomy); **IOP** – intraocular pressure; **BCVA** – best corrected visual acuity; **NLP** – no light perception.

and majority of patients (88.8%) had one or two hospitalizations (Table 2).

The most significant factors that influenced final BCVA are shown in Table 3, and included: initial BCVA (Pearson's correlation $p < 0.001$, data not shown in Table 3), ocular hypotony ($p = 0.013$), medium sized IOFB ($p = 0.037$), traumatic cataract ($p = 0.036$), retinal detachment ($p = 0.032$) and endophthalmitis ($p = 0.045$). In our study group, final BCVA was not affected by the time lapse between the injury and admission to the hospital, localization of globe wound, presence of iris injury, or

localization of IOFB ($p > 0.05$, data partially shown in Table 3).

The occurrence of retinal detachment was not affected by duration of period between the injury and admission to hospital, localization of the wound, presence of iris injury, size or localization of IOFB, or presence of endophthalmitis ($p > 0.05$, data not shown in Table 3). Interestingly, patients with retinal detachment more often had postoperatively retained IOFB in the globe ($p = 0.029$).

Occurrence of posttraumatic endophthalmitis was not associated with any of the investigated parameters including period between the injury and admission to

hospital, localization of the wound, and size or localization of IOFB ($p > 0.05$, data not shown in Table 3). In our study group, two patients (2.8%) had severe endophthalmitis on a

Table 3
Clinical factors that influence the postoperative best-corrected visual acuity (BCVA)

Variable	BCVA at discharge (mean \pm SD)	<i>p</i> -value
IOP		
normal	0.41 \pm 0.40	0.013
ocular hypotony	0.02 \pm 0.04	
secondary glaucoma	0.30 \pm 0.31	0.034
ocular hypotony	0.02 \pm 0.04	
normal	0.41 \pm 0.40	> 0.05
secondary glaucoma	0.30 \pm 0.31	
Wound localization		
corneal wound	0.31 \pm 0.37	> 0.05
scleral wound	0.43 \pm 0.41	
iris injury present	0.29 \pm 0.38	> 0.05
iris injury absent	0.41 \pm 0.37	
IOFB size		
small	0.50 \pm 0.36	0.037
medium	0.28 \pm 0.36	
small	0.50 \pm 0.36	> 0.05
large	0.24 \pm 0.42	
medium	0.28 \pm 0.36	> 0.05
large	0.24 \pm 0.42	
Lens status		
transparent lens	0.48 \pm 0.40	0.036
traumatic cataract	0.28 \pm 0.36	
Posterior segment complications		
retina attached	0.38 \pm 0.40	0.032
retinal detachment	0.13 \pm 0.19	
no endophthalmitis	0.38 \pm 0.39	0.045
present endophthalmitis	0.13 \pm 0.24	

**IOP – intraocular pressure; IOFB – intraocular foreign body;
SD – standard deviation.**

blind eye, that did not respond to any kind of treatment (both medicamentous and surgical). Due to a high risk of further propagation of infection, eventually, eyeballs had to be enucleated.

None of the patients developed sympathetic ophthalmia during the study period.

Discussion

Posterior segment penetrating eye injury is often associated with poor visual acuity at admission¹ and in our study group more than 50% of the patients initially had BCVA of counting fingers at 1 meter or less. Furthermore, those patients have worse prognosis regarding the postoperative visual outcome^{1, 8} and this was confirmed in our study group as well.

The majority of our patients were working adults (84.7%) and males (97.2%), and similar findings are found world-wide in studies of ocular trauma^{1, 9-12}. The time lapse between injury and admission to the hospital varied from 1 to 10 days, however this parameter alone did not affect the final visual acuity. Similar results were found in a study of Mansouri et al.¹².

Postoperative BCVA was significantly better than at admission. However, initial visual acuity was the most

important factor that correlated with the visual outcome ($p < 0.001$). Initial visual acuity indirectly can reflect the severity of eye injury and is important prognostic factor for postsurgical visual outcome, which has been shown in studies of other authors as well^{1, 8, 9, 13}.

Secondary glaucoma was present in 13.9% of the patients, but responded well on conservative treatment, and therefore did not significantly affect postoperative outcome. Secondary glaucoma can be caused by inflammation, trabecular meshwork disruption, or occlusion with erythrocytes, lens particles or silicon oil after PPV¹⁴. On the other hand, ocular hypotony was present in 9.7% of the patients and was associated with significantly lower postoperative BCVA (0.02 \pm 0.04), when compared to both patients with normal IOP or secondary glaucoma ($p < 0.05$). Postsurgical ocular hypotony can reflect loss of intraocular structures (vitreous, uvea etc.), residual retinal detachment or insufficiency of ciliary body, all of which are associated with poor visual outcome. Similar findings are reported in the study of Knyazer et al.⁸.

In our study, postoperative BCVA did not differ between groups with different time lapse from the injury and admission to the hospital, or between groups with corneal or scleral localization of the wound, or between groups with or without iris injury, or between groups with different

localizations of IOFB ($p > 0.05$). However, patients with small IOFB, up to 2 mm in size, had better postoperative BCVA when compared to those with medium sized (significantly better) or large IOFB. This could be explained by the fact that due to their smaller size, IOFB can cause less damage to the intraocular structures. Furthermore, surgical extraction of small IOFB is technically easier and has better postoperative prognosis.

Presence of traumatic cataract did influence the postoperative BCVA, since in those cases, cataract surgery is associated with more complications due to often present partial disruption of zonular fibers or lens capsule.

Patients with retinal detachment at presentation, had a significantly lower postoperative BCVA. This was confirmed in the study of Lin et al.¹³ and Nicoară et al.¹⁰, although other authors found no correlation^{1, 8}. The occurrence of retinal detachment was not affected by the time lapse between the injury and admission, localization of the wound, size or localization of IOFB, presence of iris injury or endophthalmitis. Interestingly, patients with retinal detachment more often had postoperatively retained IOFB in the globe ($p = 0.029$). This could be explained by the fact that IOFB passed through retina (causing retinal tear and detachment) and than was buried deeply within the globe wall. Therefore, it was not possible to surgically remove it without further damage to the eye.

Endophthalmitis is one of the most severe complications of penetrating eye injuries, with potentially devastating consequences. The known risk factors for development of endophthalmitis are delay in the wound closure, posterior segment eye injuries with disruption of crystalline lens, rural settings of injury and retained IOFB¹⁵. Since our study included only penetrating eye injuries with IOFB retained in the posterior segment of the eye, a slightly higher rate of posttraumatic endophthalmitis was observed (15.3%), when compared to other studies that included both anterior and posterior segment injuries¹⁶. However, in a study of Nicoară et al.¹⁰, considerably higher incidence of posttraumatic endophthalmitis (28.6%) was noted.

In our study group, two patients had the eye enucleated due to severe endophthalmitis and high risk of propagation of infection in the surrounding structures. Clinically, the main reasons for enucleation of the eye after penetrating injury are: development of sympathetic ophthalmia in the fellow eye, painful blind eye and, more rarely, severe endophthalmitis^{17, 18}. However, this rate is significantly lower than in a study of Rahman et al.¹⁹ (12%), which included all types of open globe injuries.

In our group of patients, there were no signs of development of sympathetic ophthalmia during the study period due to timely and adequate surgical treatment and similar results were reported by Nashed et al.²⁰ as well.

The limitations of our study include a relatively small number of patients with retinal detachment and endophthalmitis (12 and 11, respectively), making it less possible to statistically assess risk factors for those complications of posterior segment penetrating trauma. Further studies should include multicenter collaboration in assessing the severe vision threatening complications of eye injuries, in order to obtain more statistically powerful results.

Conclusion

The study was carried out in a tertiary setting and included patients with posterior segment penetrating eye injury with retained IOFB. Those patients had high frequency of low initial visual acuity, retinal detachment and endophthalmitis, all of which were shown to be risk factors for poor postoperative visual outcome. Furthermore, presence of traumatic cataract and postoperative hypotony were also associated with lower final visual acuity. Patients with smaller IOFB had better postoperative results.

Conflict of interest

The authors declare no conflict of interest.

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