

Brief report

Traumatic glaucoma due to paintball injuries: A case series

Kelly M. Lee, Christopher Seery, Albert S. Khouri*

Rutgers New Jersey Medical School, Newark, NJ, USA

Received 7 June 2017; revised 19 June 2017; accepted 20 June 2017

Available online 5 July 2017

Abstract

Purpose: To study the management and outcomes of patients with paintball injuries resulting in traumatic glaucoma.

Methods: A retrospective review was performed, identifying four patients with a confirmed diagnosis of traumatic glaucoma secondary to paintball sports.

Results: Four male patients with paintball gun injuries presented with a mean follow-up time of 51 months after the date of injury. The mean age was 23.5 ± 18.6 years. Three patients presented with blunt trauma, while one patient had a ruptured globe. Presenting visual acuity (VA) was hand motions in three of the patients and no light perception in the fourth patient. All patients were diagnosed with traumatic glaucoma and treated with glaucoma medications during their follow-up. Two patients received tube shunts to control intraocular pressures (IOPs). At the time of most recent follow-up, three patients had elevated IOPs and were not on any medications. VA at the last follow-up was 20/400 or worse.

Conclusions: Traumatic glaucoma can be managed with surgical and medical interventions, while VA usually does not return to baseline levels prior to the injury. Prognostic predictors can be used to guide treatment and identify patients who should be closely followed. Because the presentation and onset is widely variable, follow-up and screening is crucial even years after the injury.

Copyright © 2017, Iranian Society of Ophthalmology. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Paintball; Ocular trauma; Glaucoma; Secondary glaucoma

Introduction

Recreational sports such as paintball “war games” have contributed to the estimated 2.5 million eye injuries that occur in the US each year.¹ Paintballs are small projectiles that can be fired at up to 90 m per second,² while as a comparison, a 0.38 caliber handgun can fire a bullet at 260 m/s.³ Most injuries are blunt traumas and can range from mild to potentially fatal, some manifesting much later as secondary glaucoma. The mechanism for elevated intraocular pressure (IOP) includes impairment of the trabecular meshwork by direct injury

or angle recession, hyphema, inflammation, injury to the lens and/or iris, and peripheral anterior synechiae⁴ among others.

Although glaucoma is noted as a complication of paintball injuries, there have been no published reports solely on glaucoma and its progression after paintball injury.^{5,6} In this report, we present 4 cases of traumatic glaucoma due to paintball injuries and look at the specific management and outcome of this complication.

Methods

IRB approval was obtained to perform a retrospective chart review of 221 patients with a confirmed diagnosis of traumatic glaucoma (ICD 9 code of 365.65 and ICD 10 code of H40.30–H40.33) during the period from January 2009 to January 2015 at a tertiary, level one trauma center. Data collected included demographic information such as the

No conflicts of interest from any of the authors.

* Corresponding author.

E-mail address: Albert.khouri@rutgers.edu (A.S. Khouri).

Peer review under responsibility of the Iranian Society of Ophthalmology.

patient's age, gender, race, and a comprehensive exam was performed, including visual acuity (VA), IOP, and number of glaucoma medications. Of those patients, we identified four patients whose injuries were confirmed to be secondary to paintball sports and have presented them below. Table 1 summarizes the findings of the four patients.

Results

Case 1

A 19-year-old male presented with a left ruptured globe after getting hit by a paintball. He also presented with a partial thickness corneal laceration, traumatic cataract, vitreous hemorrhage, lens fragments in the anterior chamber, iridodialysis, and eventual scarring in the posterior pole (Figs. 1 and 2). His presenting vision was hand motions. At 3 weeks after the injury, his IOP rose to 51 mmHg while on 1 topical glaucoma medication and remained elevated at subsequent visits despite maximal therapy. Baerveldt tube shunts were placed 1.5 months after the injury. Five years after the injury, his VA improved to 20/400, while his IOP was 23 mmHg without any glaucoma medications.

Case 2

A 51-year-old male received blunt trauma to the right eye due to a paintball gun. He presented to the clinic 19 months after the trauma with an IOP of 46 mmHg while on 3 topical glaucoma medications and no light perception. He received cyclophotocoagulation (CPC) 21 months and 23 months after the injury. Over two years after the injury, his IOP was 28 mmHg without any glaucoma medications and the same visual acuity of no light perception.

Case 3

A 13-year-old male was hit by a jet of compressed air from an unloaded paintball gun, resulting in blunt trauma to the right eye, as well as traumatic cataract, vitreous hemorrhage, hyphema, subluxation of the lens, choroidal rupture involving the macula, iridodialysis, and retinal dialysis. His presenting acuity was hand motions and IOP was 12 mmHg. He had Baerveldt tube shunts placed 5 months after the injury, as his IOP prior to the intervention was 49 mmHg while on 3 glaucoma medications and had been consistently elevated on

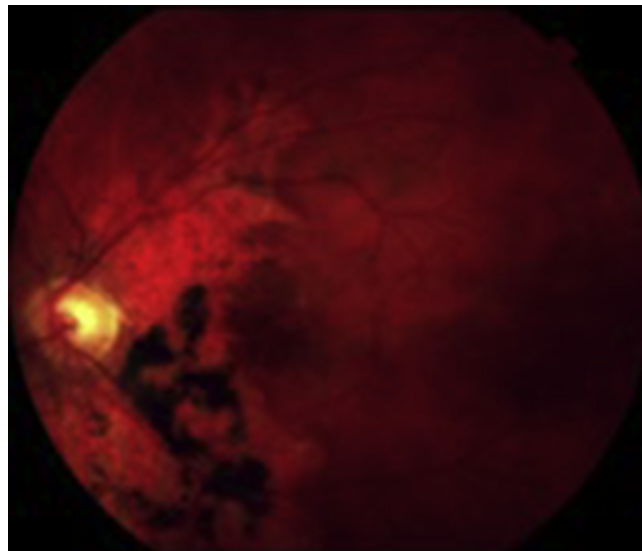


Fig. 1. Fundoscopic view of patient with vitreous hemorrhage (case 1).

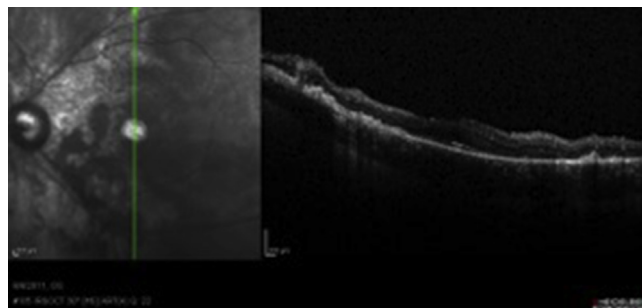


Fig. 2. Optical coherence tomography (OCT) image of patient's retina showing edema (case 1).

more than 2 occasions. 32 months after the injury his IOP was 28 mmHg off of glaucoma medication. VA slightly improved to counting fingers.

Case 4

An 11-year-old male received blunt trauma to the right eye after being hit by a paintball and was transferred from another hospital. He also presented with vitreous hemorrhage, hyphema, subluxation of the lens, retinal detachment, and commotio retinae. He could only see hand motions and his IOP was 7 mmHg. Four years after the injury, his IOP was elevated

Table 1
Summary of findings.

	Initial IOP (mmHg)	Initial VA	Final IOP (mmHg)	Final VA	Surgery	# of glaucoma medications at last visit	Follow-up (months)
Case 1	51	Hand motions	23	20/400	Baerveldt tube	0	63
Case 2	46	No light perception	28	No light perception	none	0	28
Case 3	12	Hand motions	28	Counting fingers	Baerveldt tube	0	32
Case 4	7	Hand motions	13	Counting fingers	none	2	84

IOP: Intraocular pressure; VA: Visual acuity.

(up to 32 mmHg). He was started on topical therapy and IOP was medically controlled at 13 mmHg on his last visit 7 years after the injury. VA was reduced to counting fingers.

Discussion

The four cases described highlight the development of secondary glaucoma and its management following ocular paintball trauma. Two of the patients received surgical intervention for glaucoma in the form of tube shunts, while one patient received glaucoma laser cilioablation treatment. The four patients were all on topical glaucoma medications at some point of follow-up. Three of the patients, regardless of whether they had surgical intervention, showed elevated IOP greater than 21 mmHg at the most recent visit while on no glaucoma medications. One patient maintained normal IOP while on 2 glaucoma medications at the final follow-up. Two cases did not present with increased IOP until over a year after the injury, while the other two started having elevated IOP within 5 months of the injury. VA may have improved minimally in the majority of the cases, however vision never returned to baseline.

This is the first study to our knowledge to focus on secondary glaucoma in paintball injuries and follow patients over an extended period of time ranging from 28 to 84 months after the date of initial injury. Follow-up interval in the study by Alliman et al. had a mean of 11.7 months, while the maximum follow-up in the study by Taban et al. was 13 months. Most of the current literature regarding paintball injuries only points out glaucoma as one out of the many possible complications and instead emphasizes the immediate complications (hyphema, vitreous hemorrhage, cataracts) and those managements.⁷ The prognosis for return to baseline VA was poor in this study as well as in others.^{6–9}

Previous studies show that certain risk factors are associated with the need for glaucoma surgery. Those risk factors are corneal injury, presence of optic atrophy, VA <20/200, or hyphema.¹⁰ All patients receiving glaucoma surgery in our study had one or more of these predictive factors, including hyphema, corneal injury, and low VA. Some findings on initial presentation have been associated with a higher risk of developing traumatic glaucoma, such as elevated baseline IOP, hyphema, lens displacement, and angle recession of more than 180°.^{10,11} The four patients showed at least one of these characteristics at the initial clinic visit (Table 2).

Although paintball ocular injuries and the ensuing traumatic glaucoma are rare, this cause is entirely avoidable by following proper safety measures, including the strict use of eye protection.

In conclusion, paintball injuries to the eye can cause underlying damage that may not manifest until years after the injury. For patients sustaining traumatic glaucoma after a

Table 2
Summary of complications.

Complications	# of patients
Anterior segment	
Hyphema	2
Traumatic cataract	2
Iridodialysis	2
Subluxation of the lens	2
Corneal injury	1
Angle recession	1
Posterior segment	
Vitreous hemorrhage	3
Posterior pole injury	1
Retinal detachment	1
Retinal dialysis	1
Commotio retinae	1
Choroidal rupture	1

paintball injury, surgical intervention may not be enough to control pressures. Medications may be necessary even after surgery to manage glaucoma. This highlights the importance of prevention as well as regular follow-up and screening.

References

1. May DR, Kuhn FP, Morris RE, et al. The epidemiology of serious eye injuries from the United States Eye Injury Registry. *Graefes Arch Clin Exp Ophthalmol*. 2000;238(2):153–157.
2. American Society for Testing and Materials, Standard Practice for Paintball Field Operation. *1997 Annual Book of ASTM Standards*. West Conshohocken, PA: American Society for Testing and Materials; 1997: 1400–1401.
3. Pahk P, Adelman R. Ocular trauma resulting from paintball injury. *Graefes Arch Clin Exp Ophthalmol*. 2009;247(4):469–475.
4. Milder E, Davis K. Ocular trauma and glaucoma. *Int Ophthalmol Clin*. 2008;48(4):47–64.
5. Sponzel WE, Gray W, Scribbick FW, et al. Blunt eye trauma: empirical histopathologic paintball impact thresholds in fresh mounted porcine eyes. *Invest Ophthalmol Vis Sci*. 2011 Jul;52(8):5157–5166.
6. Alliman K, Smiddy W, Banta J, Qureshi Y, Miller D, Schiffman J. Ocular trauma and visual outcome secondary to paintball projectiles. *Am J Ophthalmol*. 2009;147(2), 239–242.e1.
7. Farr AK, Fekrat S. Eye injuries associated with paintball guns. *Int Ophthalmol*. 1999;22(3):169–173.
8. Listman DA. Paintball injuries in children: more than meets the eye. *Pediatrics*. 2004;113(1 Pt 1):15–18.
9. Gedde S, Singh K, Schiffman J, Feuer W. The tube versus trabeculectomy study: interpretation of results and application to clinical practice. *Cur Opin Ophthalmol*. 2012;23(2):118–126.
10. Ozer P, Yalvac I, Satana B, Eksioğlu U, Duman S. Incidence and risk factors in secondary glaucomas after blunt and penetrating ocular trauma. *J Glaucoma*. 2007;16(8):685–690.
11. Sihota R, Kumar S, Gupta V, et al. Early predictors of traumatic glaucoma after closed globe injury: trabecular pigmentation, widened angle recess, and higher baseline intraocular pressure. *Arch Ophthalmol*. 2008;126(7): 921–926.