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Research Article

A RETROSPECTIVE OBSERVATIONAL STUDY OF THE OCULAR GUN PELLET INJURIES AND THEIR MANAGEMENT

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A B S T R A C T

Purpose: To assess clinical profile and outcome of patients with ocular pellet injury (OPI) in the Indian patients who visited our hospital.
Material and Methods: Records of all patients who had OPI from 2014 to 2018 were reviewed and analyzed retrospectively for effects of pellet injury on the eye and their management.
Results: During the study period, 81 patients (79 males and 2 females) were found to be affected. Mean age at presentation was 20.73 years (Range 10-56 years) with a mean follow up period of 6.9+/-4 months (1-18 months). 65, 8 and 1 patients had improvement, maintenance and worsening of the final BCVA respectively. 3 eyes were unsalvageable, and 4 patients were lost to follow up. 35(43.21%) patients had post-operative complications with re-detachment being the most common (23.46%). After the treatment, there was a significant improvement in the visual acuity ($p < 0.001$). Intra-ocular foreign body (IOFB) was removed from 30 eyes. In 39/51 eyes which had a perforating injury, the pellet was lodged in the retro-bulbar area.
Conclusion: OPI causes serious visual decline due to vitreous hemorrhage, cataract and retinal detachment. However, proper diagnosis and treatment can significantly improve the final visual outcome.

INTRODUCTION

Ocular injury/trauma is a major cause of visual loss. Worldwide, different causes have been proposed, which are categorized into domestic, occupational, sports, road traffic accidents, iatrogenic, fights and assaults, and war injuries (Lone IA *et al*., 2014; Tabatabaei SA *et al*., 2018).

Ocular pellet injuries (OPI) have recently been on a rise. Pellet gun cartridges usually break into small iron pellets and can penetrate any body tissue including eyes: velocity and distance of the pellet determines the nature of the eye injury(Lone IA *et al*., 2014). The OPI usually result from the use of airsoft guns in children and adolescents as toys (Devi NS*et al*., 2018; Tabatabaei SA *et al*., 2018) or by pellet firing for security purposes as a nonlethal weapon(Lone IA *et al*., 2014; ObengFK *et al*., 2017).

Our country faces the major problem of Ocular injuries following pellet gun fire in the Kashmir Valley (India) over the past many years. The bystanders are the ones affected due to the clashes between terrorists, who may fireairguns and security personnel who fire pellet gun cartridges to disperse the agitated mobs, considering it to be a nonlethal weapon.

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Ocular injuries and fatalities resulting from such weapons have called for measures to raise public awareness and for legislative changes. Thus, here in this study we review and report a large number of ocular pellet gun injury cases that are being reported from Kashmir, and were treated and managed at our hospital in a 5-year time frame. Patients' demographics, type of injury, choice of management, treatment outcomes including the final visual acuity and complications are reported.

METHODS

A retrospective Observational Cohort Study was conducted in the Department of Ophthalmology from 2014 to 2018; where the relevant data regarding the demographic, ocular injury, management and complications, requirement for further surgery and final visual outcomes of the patient who were admitted to the hospital with gun pellet injury, were collected and reported. Patients with a preinjury history of ipsilateral amblyopia or previous ocular trauma were excluded from the study. All patients were victims of gun pellet injuries, and all of them were resident of Kashmir Valley. A written informed consent was taken from the patients. However, due to the retrospective observational nature of the study, hospital ethical committee clearance was not taken for carrying out the study.
The sample size was calculated on the basis of the study byObengFK *et al*., (2017)who observed that pre and final best

corrected visual acuity was 0.12 ± 0.12 and 0.19 ± 0.21 respectively. Taking these values as reference, the minimum required sample size with 95% power of study and 5% level of significance is 77 patients. To reduce margin of error, total sample size was taken to be 81.

Detailed history about the type of injury was obtained from all the patients. The case records about complete ophthalmic examination; which included best corrected visual acuity (BCVA) at presentation and follow up visits, intraocular pressure (IOP), ocular injury status; type of surgery, complete management and its complications were obtained. Specific variables of a system for classifying mechanical injuries of the eye were analyzed: the type of injury (defined by the mechanism of injury), grade of injury (defined by initial visual acuity), zone of injury (defined by the location of the wound), and relative afferent pupillary defect (Pieramici DJ *et al*., 2003).All surgeries were performed by 3 experienced vitreoretinal surgeons. The records regarding the Intra-ocular foreign body lodgment and the search with B-scan imagingwas also obtained.

All the patients underwent 23 gauge pars plana vitrectomy (PPV) under local anaesthesia. The standard surgical procedure followed was- primary repair (where required), belt buckling, 23 G PPV, posterior vitreous detachment induction, lensectomy (where required), perfluorocarbon liquid (pfcl) injection or Fluid air exchange, endolaser / anterior retinal cryo for breaks, pfcl/silicon oil (so) exchange or so injection/sf6 gas as tamponade. Concurrent lensectomy was performed in eyes, all of which had correction of aphakia with posterior chamber scleral fixation of intraocular lenses (PCSFIOL) at least 8 weeks after the lensectomy. At the end of surgery all patients received subconjunctival dexamethasone and subsequently, use of combination of topical steroid and antibiotic. Oral treatment given were ciprofloxacin and non-steroidal anti-inflammatory drugs. Patients were followed up at 12 weeks after the initial surgery.

Statistical Analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. The Snellen BCVA was converted into logarithm of the minimum angle of resolution (logMAR) units for statistical analysis. Patients whose visual acuities were hand motion were assigned the equivalence of 1.7 logMAR units. Normality of data was tested by Kolmogorov-Smirnov test. If the normality is rejected then non parametric test were used.

Statistical tests were applied as follows

1. Quantitative variables were compared using /Mann-Whitney Test (as the data sets were not normally distributed) between the two groups.
2. Qualitative variables were compared using Chi-Square test. The data were entered in MS EXCEL spreadsheet and analysis were done using Statistical Package for Social Sciences (SPSS) version 21.0.

A p value of <0.05 were considered statistically significant.

RESULTS

Themean age at presentation was 20.73 years (Range 10-56 years) with a mean postoperative follow up period of 6.9+/-4 months (Range 1-18 months). There were 79 males and only 2 females.(Table 1)

Among the 81 study patients, the most common type of injury was Type C (50.62% cases) followed by Type D (24.69% cases) and Type B (19.75% cases). Grade 4 was the commonest as seen among 58(71.6% cases). Among the various zones affected, Zone 1 was involved in 38(46.91%) followed by Zone 2 in 26(32.1%) and Zone 3 in 11(1.23%) cases. The injury was perforating among 51(62.96%) patients and penetrating in 30(37.04%) patients. (Table 2) At presentation BCVA ranged from light perception to 6/12.

Intra-ocular foreign body (IOFB) was found and removed in all 30 eyes with penetrating injuries. In most of the perforating injuries, where the pellet was not located in the eye, it may have been lodged in the retro or peri-bulbar area. In most cases, primary repair of entry wound was done at a local hospital of the patient. Further management was done at our hospital for the patients which were referred.

On slit lamp examination, the commonest area affected was cornea (35.8% cases) followed by scleral (34.57%) and corneoscleral in 29.63% cases. Retinal detachment was seen in only 19(23.46%) cases.

At last follow up, 65, 8 and 1 eyes had improvement, maintenance and worsening of the final BCVA, respectively. 3 eyes were unsalvageable, 7 patients were lost to follow up. The patients suffered from a variety of complications from the initialvitreoretinal surgery that included recurrent RD in 20.99% patients, ERM in 11.11% patients, secondary glaucoma in 9.88% patients, vitreous/choroidal hemorrhage (VCH) in 8.64% patients, pre-retinal hemorrhage in 6.17% patients, hyphema in 4.94% patients, subretinal hemorrhage in 2 patients, and retinal incarcination and foveal dragging in 1 patient each(Figure 1).

Overall, there was a significant improvement in the visual acuity after the operation with mean(SD) values decreasing from log MAR 2.42(1.05) to 0.82(0.67) ($p < 0.001$).

On comparison of penetrating and perforating injuries, penetrating injury had significantly more retinal detachment cases (36.67% vs 15.69%, P=0.031), comparable number of complications (36.67% vs 47.06%, P=0.362), and comparable median improvement in V/A (2.08 vs 1.3, P=0.296) (Table 3).

Table 1 Demographic characteristics of study subjects.

Demographic characteristics	Frequency	Percentage
Age(years)		
10-14	4	4.94%
55-60	1	1.23%
15-19	35	43.21%
20-24	28	34.57%
25-29	9	11.11%
30-34	3	3.70%
35-39	1	1.23%
Mean ± Stdev	20.73 ± 6.1	
Median(IQR)	20(17-22)	
Range	10-56	
Gender		
Female	2	2.47%
Male	79	97.53%

Table 2 Characteristic of gun pellet injury of eye

Characteristic of gun pellet injury of eye	Frequency	Percentage
Type of injury		
Type B	16	19.75%
Type C	41	50.62%
Type D	20	24.69%
TypeC/D	1	1.23%
Type E	1	1.23%
Type L	1	1.23%
Type Z	1	1.23%
Grade of injury		
Grade 1	6	7.41%
Grade 2	8	9.88%
Grade 3	7	8.64%
Grade 4	58	71.60%
Grade 5	2	2.47%
Zone of injury		
Zone 1	38	46.91%
Zone 1 & 2	5	6.17%
Zone 2	26	32.10%
Zone 3	11	13.58%
Zone corneal suture	1	1.23%
Diagnosis		
Penetrating injury	30	37.04%
Perforating injury	51	62.96%

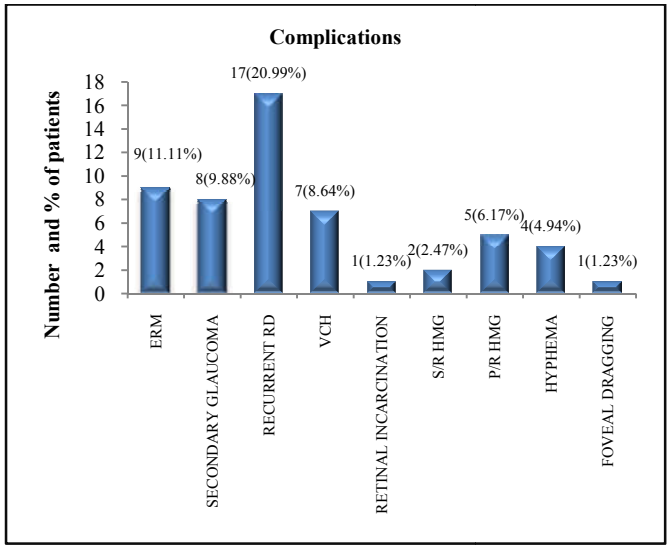

Figure 1 Distribution of complications of study subjects

ERM: Epiretinal membrane; S/R HMG: Subretinal haemorrhage; P/R HMG: Pre-retinal haemorrhage; VCH: vitreous/choroidal hemorrhage

Table 3 Comparison of outcomes between penetrating/perforation injury.

Variables	Penetrating injury(n=30)	Perforating injury(n=51)	Total	P value	Test
Retinal detachment					
No	19(63.33%)	43(84.31%)	62(76.54%)	**0.031**	Chi square test,4.631
Yes	11(36.67%)	8(15.69%)	19(23.46%)		
Complications					
No	19(63.33%)	27(52.94%)	46(56.79%)	0.362	Chi square test,0.831
Yes	11(36.67%)	24(47.06%)	35(43.21%)		
Improvement in V/A					
Mean ± Stdev	1.72 ± 0.96	1.45 ± 1	1.56 ± 0.99	0.296	Mann Whitney test;513.5
Median(IQR)	2.08 (1.155-2.48)	1.3 (0.45-2.38)	1.6 (0.55-2.48)		
Range	0-2.88	-3.18	-3.18		

DISCUSSION

The reports in India regarding the ocular pellet injuries have been talked about mainly because of firings and mob quilling in Kashmir valley. Security forces have been using pump action shot weapon or pellet gun in Kashmir Valley over the previous few years to disperse violent mobs. Pellet guns were implemented for crowd control as non-lethal weapons. Previous reports have been published from Kashmir valley where the study included only 20 patients(Lone IA *et al*., 2014)and 33 eyes of 32 patients (ObengFK *et al*., 2017). The present study reports a much higher data of81 patients. To our knowledge, no other similar report has been published on OPI from India based on the Kashmir valley pellet firings.

The mean age of our patients was 20.73 years (range 10-56 years), and the most common age group of patients was 15- to 19-year-old. In a study by Tabatabaei SA *et al*., (2018) mean age of patients was 25.7 ± 15.6 years with most of the patients belonging to age group 16- to 45-year-old. In contrast, few studies have reported a younger age group of 13-18 years with OPI (Langley JD *et al*., 1996; Schein OD *et al*., 1994; ShuttleworthGN *et al*., 2009).

Our data indicated a male to female ratio of 40:1 for pellet gun eye injuries which is in line with previous studies reporting higher incidence of these injuries in males (Purtskhvanidze K *et al*., 2017;ShuttleworthGN *et al*., 2009). Tabatabaei SA *et al*., (2018) in their study of 111 cases reported 5.7 to 1 male to female ratio. In study by Lone *et al*., (2014) out of 20 cases, 19 were males and 1 female. Patel *et al*., in a review of 202 cases of penetrating eye injury have reported a 4.66 to 1 male to female ratio. Bowen *et al*., (2017) in a study of 105 cases with pellet gun injuries from England have reported a 7.5:1 male to female ratio. In a report of 718 cases of air gun injuries from New Zealand by Langley JD*et al*., (1996) this ratio was 6 to 1. Both hospital and population-based surveys show a high prevalence of eye injuries affecting young men as was the case in our research. The patients who reported to our hospital were mostly injured as a bystander effect of the pellets. It seems that more males were near the incidence of pellet firing due to the more outgoing nature of males compared to females; and the higher popularity of air guns among men both as a toy or hunting weapon can describe the statistically higher number of injuries among the male population.

The spectrum of ocular injury in this series was found to be similar to other studies, but perhaps the most important feature to appreciate was the severity of the type of injuries. In our study, most common ocular injury was retinal detachment. Lone *et al*.(2014) noted hyphema to be the most common manifestation of gun pellet injuries (82.6%). DeviNS *et al*., (2018) also reported hyphema to be present in majority of the cases (85.8%). This was due to the reported use of nonpowder firearm injuries.

In this study, we found that majority of the injuries (62.96%) were perforating. Lone *et al*. (2014) noted that in 78.26% cases, injuries were open globe penetrating type. This pattern can be explained by the fact that ocular penetration can occur at muzzle velocities as low as 130 foot pounds/sec and anything above that can cause perforation of the eye, and it has been seen that nonpowder fire arms can generate muzzle velocities of upto200–900 foot pounds/sec which causes perforation (Laraque D*et al*., 2004; Scribano PV *et al*., 1997). Moreover, from a single cartridge, more than 500 pellets can

be fired, thus accounting for a high incidence37% of penetrating trauma in the study.

It is to be noted that penetrating injuries showed significantly higher incidence of retinal detachment as compared to the perforating injuries, however, other complications and the improvement in the BCVA after the surgery were statistically similar.In contrast, among the previous studies, it was seen that such classification of open globe injuriesmay become a useful prognostic tool for visual outcome in posterior segment ocular injuries managed with vitrectomy (GlobocnikPetrovic M *et al*., 2004). Recently also, the classification and categorization of the injuries have been revised. The newer classification improvised by Shukla B *et al*., (2017)has also been found to correlate with the outcomes and may be taken into account in the future studies.

In our study, IOFB was removed from all 30 eyes. Tabatabaei *et al*., (2018) noted that foreign body was present in 83% patients. This was reported to be 50% in a study by Khoueir *et al*., (2015) and 75% in the study by Shuttleworth GN *et al*., (2009). Lone *et al*., (2014) found that retained IOFB was seen in six eyes (26.08%). Retained pellets are best located by plain orbit X-rays, although extra information can be acquired from computed tomography scans and ocular B-scans in chosen instances.

Concurrent lensectomy was done in 30 eyes. This is in accordance with the study performed by KhoueirZ *et al*., (2015) who reported that in 50% of patients, combined lensectomy and vitrectomy was performed. Lensectomy and vitrectomy was the most common treatment method performed on 31.5% eyes in study by Tabatabaei *et al*., (2018). In study by Devi NS*et al*., (2018) 18 out of 92 cases required surgery while the rest were treated conservatively.In our study, Retinal detachment, especially at the site of the exit wound was the most common post-operative complication.Mean number of surgeries per eye was 2.2 (range 1-8). The grave nature of injury accounts for increased risk of re-detachment and hence need of multiple surgeries.

The preoperative logMAR value of BCVA was 2.42 ± 1.05 and postoperative logMAR value was 0.82 ± 0.67, which showed statistically significant improvement. Our study results were in line with the study by Tabatabaei *et al*., (2018)who reported that the pre-treatment logMAR of the injured eye patients were 2.56 ± 1.38 which improved to 2.05 ± 1.5 six months post-treatment, indicating a statistically significant improvement. In a similar study by ShuttleworthSN*et al*.,(2009) on patients with air gun eye injuries, the mean visual acuity at presentation was 1.23 ± 1.05, which improved to 0.81 ± 1.25, thus indicating significant improvement. The treatment was seen to significantly improve the final visual acuity as compared to the presenting vision; but the improved vision was still not comparable to the general normal population.

Unfortunately, ocular pellet gun injuries have been on the rise over the previous few years in Kashmir Valley (India). The security personnel fire pellet gun cartridges, considering it as a non-lethal weapon: to reduce agitated mobs; but the ocular injury sustained by the pellets causes serious vision loss.Public and security forces awareness about the subject and knowledge about the treatment of such cases for the emergency departments in the hospitals is the key for successful alleviation of such ocular pellet injuries.

One of the limitations of our study is its retrospective nature. Also, our study was a single-center hospital-based study, so its results cannot be extrapolated to study the prevalence of OPI in the general population. Another main limitation of the present study was that it was conducted among patients coming to a referral center in Amritsar. It is a known fact that majority of our patients were those with a more severe injury that were considered to be advanced cases and thus referred. This may indicate that our results on the severity of injury and poor visual results may be worse than the patients' ordinary average. The strength of the study was its sample size which was quite reasonably large as compared to other researches. Our study shows that the vision can be significantly improved in the cases of OPI, if diagnosed and treated appropriately.

CONCLUSION

Gun pellet-related ocular injuries are becoming increasingly common in Kashmir Valley. These injuries are found more commonly in young age patients especially among young male patients. The most common treatment was lensectomy. Treatment significantly improves Visual acuity but despite appropriate therapy, the visual prognosis remains poor. Final visual outcome after treatment may depend upon the presenting BCVA, location of the pellet, exit wound on the retina, and type of pellet. Perforation exit site and the first impact site in IOFB injury are the sites from where retinal detachment is most likely to occur. Measures to decrease the use of gun pellets in our community are highly proposed to decrease preventable visual impairment.

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Conflicts of interest : None

References

Bowen,D.I. and Magauran,D.M. 2017.Ocular injuries caused by airgun pellets: an analysis of 105 cases. Br Med J. 1973;1(5849):333-337.wire brushes.

Devi,N.S., Singh,L.J. and Singh,K.N. 2018. Ocular injuries due to airsoft gun pellets over an 8-year period. J. Med. Soc., 32:103-105.

GlobocnikPetrovic, M., Lumi, X. and Drnovsek Olup, B. 2004.Prognostic factors in open eye injury managed with vitrectomy: retrospective study. Croat. Med. J., 45(3):299-303.

Khoueir, Z., Cherfan, G. and Assi, A. 2015.Vitreoretinal surgery for shotgun eye injuries: outcomes and complications. Eye.Lond., 29(7):881-887.

Langley, J.D., Robyn, N.N., Alsop, J.C.and Marshall S.W. 1996.Airgun injuries in New Zealand, 1979-92. Inj. Prev., 2(2):114-117.

Laraque, D., American Academy of Pediatrics Committee on Injury, Violence, and Poison Prevention. 2004. Injury risk of nonpowder guns. Pediatrics., 114:1357-1361.

Lone,I.A., Rashid, W., Shaheen, N.and Sajjad, S. 2014. Pattern of gun pellet ocular injuries in Kashmir, India. Afr. J. Trauma., 3:76-80.

Obeng,F.K., Vig,V.K., Singh, P., Singh, R. and Sahajpal, N. 2017.Management of ocular pellet injury.Global. J. Med. Res., 17(5):version 1.0.

Pieramici,D.J., Au Eong,K.G., Sternberg, P. Jr. and Marsh,M.J. 2003.The prognostic significance of a system for classifying mechanical injuries of the eye

(globe) in open-globe injuries. J. Trauma., 54(4):750-754.

Purtskhvanidze, K., Ru¨fer, F., Klettner, A., Borzikowsky, C. andRoider, J. 2017.Ocular Trauma Score as prognostic value in traumatic ocular injuries due to rotating wire brushes. Graefes. Arch. Clin. Exp. Ophthalmol., 255(5): 1037-1042.

Schein,O.D., Enger, C. and Tielsch,J.M. 1994. The context and consequences of ocular injuries from air guns. Am. J. Ophthalmol., 117(4):501-506.

Scribano,P.V., Nance, M., Reilly, P., Sing,R.F. andSelbst,S.M. 1997. Pediatric nonpowder firearm injuries: Outcomes in an urban pediatric setting. Pediatrics., 100:E5.

Shukla, B., Agrawal, R., Shukla, D. and Seen, S. 2017.Systematic analysis of ocular trauma by a new proposed ocular trauma classification.Indian. J. Ophthalmol., 65:719-722.

Shuttleworth,G.N., Galloway, P., Sparrow,J.M. and Lane, C. 2009. Ocular air gun injuries: a one-year surveillance study in the UK and Eire (BOSU). 2001-2002. Eye.Lond., 23(6): 1370-1376.

Tabatabaei, S.A., Soleimani, M., Rajabi,M.B., Ahmadraji,A.A., Khodabandeh, A. andBeheshtnejad, A., *et al*. 2018. Pellet gun injury as a source of ocular trauma; a retrospective review of one hundred and eleven cases. J. Curr. Ophthalmol., 30:239-244.

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