CASE REPORT

Nerf gun eye injuries: traumatic hyphema

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SUMMARY

Three unrelated patients attended the accident and emergency department with pain and blurred vision after ocular injury with a Nerf gun. Two were adults and one was a child, all of which presented within a 3 months' period. All three cases were found to have ≥ 1 mm of traumatic hyphema (pooling of blood in anterior chamber of the eye), indicating significant ocular trauma. The two adult patients had formed hyphema and uveitis. The 11-year-old child had formed hyphema, corneal oedema, anterior uveitis, localised angle recession and commotio retinae, which further highlight the severity of the ocular trauma. Significant Nerf gun ocular injuries are not reported in the literature, as far as we know. This case series serves to raise awareness of the seriousness of Nerf gun ocular injuries. It encourages further exploration of reasons for such injuries, as well as a review of protective measures against ocular trauma.

BACKGROUND

This is a case series of three cases that presented to the ophthalmic accident and emergency (A&E) department following Nerf gun injuries. The two adult cases had hyphema, and the child had hyphema, uveitis, angle recession and commotio retinae. Nerf guns are widely used by children, and it is important that the public is made aware of the potential for serious ocular injury.

CASE PRESENTATION

A 32-year-old male presented to ophthalmic A&E having been shot in the eye by a child the day before from an approximate distance of 8 m. The patient was complaining of blurred vision and a red eye. The patient was myopic, with an uncorrected visual acuity of 2/60 (US annotation: 20/600) in the right eye, improving to 6/24 (20/80) with a pinhole.

Figure 1 Anterior segment photo of right eye of male adult patient taken 1 day after Nerf gun bullet injury.

On examination, there was no obvious corneal, conjunctival or scleral injury. The anterior chamber was full of circulating red blood cells (RBCs), with a 1.8 mm formed hyphema (see [figure 1](#)). The density of the RBCs obscured the fundus view, meaning that inspection of the fundus was not possible. Intraocular pressure was 17 mm Hg in the right eye and 14 mm Hg in the left eye.

A 43-year-old female presented to ophthalmic A&E having been shot in the eye 3 hours prior to presentation. The right eye was shot directly by a Nerf gun from a distance of 1 m. The patient was complaining of blurred vision and a red sore eye. The patient was myopic (-4.5 dioptres of myopia), with a corrected (with spectacles) visual acuity of 6/12 (20/40) in the right eye, improving to 6/9 (20/30) with a pinhole. On examination, there was no obvious corneal, conjunctival or scleral injury. The upper lid was bruised indicating that the lids were closed when the bullet hit the eye. Intraocular pressure was 13 mm Hg in the right eye and 12 mm Hg in the left eye. The anterior chamber was full of circulating RBCs, with a 1 mm formed hyphema. The density of the RBCs obscured the fundus view, meaning that thorough inspection of the fundus was not possible.

An 11-year-old child presented to ophthalmic A&E with a right eye traumatic Nerf gun injury that occurred 5 hours prior to presentation. The eye was shot from a distance of 2 m by a Nerf gun. The child was complaining of pain and blurred vision. Ocular history included wearing spectacles, and there was no history of amblyopia. On examination, unaided visual acuity was 6/9+3 (20/25) in the right eye and 6/5-1 (20/16) in the left eye. There was right eye corneal oedema, numerous red cells circulating in the anterior chamber, with a 1.5 mm formed hyphema (see [figure 2](#)). There was also evidence of right eye acute anterior uveitis. Intraocular pressure was 13 mm Hg in the right eye and 9 mm Hg in the left eye. On fundus examination, there was a hazy view secondary to the cornea oedema and anterior chamber cells. The view was sufficient to rule out obvious retinal detachments. There was evidence of inferonasal commotio retinae. No other abnormalities were detected on left eye fundus examination.

INVESTIGATIONS

As the fundus view was obscured, the 32-year-old man and 43-year-old woman had ultrasound B-scans of the injured eye. This confirmed that the retina was flat (no retinal tear or detachment). The ultrasound B-scan in [figure 3](#) shows the hyphema in the 32-year-old man.

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Figure 2 Anterior segment photo of right eye of paediatric patient taken 6 hours after Nerf gun bullet injury.

TREATMENT

The 32-year-old male right eye was treated with Predsol eye drops 0.5% four times daily for 1 week and twice daily for 1 week, as well as cyclopentolate 1% twice daily for 5 days.

The 43-year-old woman was treated with hourly dexamethasone 0.1% eye drops due to the presence of significant number of anterior chamber cells, indicating ocular inflammation. This was tapered down over 4 weeks. Additionally, the patient was prescribed topical betnesol eye ointment to use at night for 1 week and cyclopentolate 1% eye drops twice daily for 5 days for pain control.

The 11-year-old child was treated with dexamethasone 0.1% eye drops for the traumatic acute anterior uveitis and cyclopentolate 1% drops for cycloplegia and pain relief.

Figure 3 Ultrasound B-scan of adult male patient showing traumatic hyphema (red arrow points to the blood), but no posterior globe injuries.

OUTCOME AND FOLLOW-UP

The 32-year-old male attended for follow-up 3 weeks later. His best corrected visual acuity was back to normal and equal in both eyes. The hyphema had resolved and no other abnormalities were found.

The 43-year-old female did not attend follow-up. On contacting the patient 6 weeks later, she reported complete resolution of symptoms and vision returning to normal.

The 11-year-old child presented for review the next day. The only change in examination finding was the presence of keratic precipitates at the inferior third of the cornea, supporting the presence of anterior uveitis. Treatment with steroid drops and cycloplegia was continued. The child then attended follow-up 1 week later. On examination, the hyphema, uveitis and commotio retinae had resolved, and visual acuity had returned to normal. Gonioscopy showed one clock hour of angle recession, which was not thought to be sufficient to cause long-term risk of raised intraocular pressure. Dexamethasone 0.1% eye drops were continued four times a day for 1 week then twice per day for 1 week, and the child was discharged from further follow-up.

DISCUSSION

Eyes are the third most commonly injured body part.¹ The common mechanisms of injury show variance in the developed world as compared with the developing world, as well as variance in the availability of treatments.² This may explain the wide variability in visual outcome following ocular injuries with traumatic hyphema.²⁻⁴

The most common form of physical injury is blunt trauma in children, which in turn is the most common cause of traumatic hyphema.^{4,5} In children, the most common mechanism of injury has been reported general play (toys, in particular projectiles from guns) and sports injuries.^{4,6-8} In our case series, both the paediatric patient and adult patients were shot with Nerf guns by children. As far as we know, this commonly used projectile 'toy' gun has not been reported in the literature as a cause of traumatic hyphema. This is in contrast to airsoft pellet guns, which are well reported in the literature as a cause of traumatic hyphema.⁹⁻¹³ In a retrospective study of 138 children with unilateral traumatic hyphema (Colorado, USA), three out of four patients requiring glaucoma surgery incurred ocular trauma due to a plastic or metal pellet from an air gun.⁶

Our case series presents traumatic hyphema resulting from a Nerf gun, which is thought to produce a more 'innocuous' injury than a pellet gun. The resultant trauma from the Nerf gun has been sufficient to cause hyphema in all three patients. It also resulted in acute anterior uveitis in one of the two adults, and corneal oedema, acute anterior uveitis, angle recession and peripheral commotio retinae in the 11-year-old child. The hyphema occupied less than one-third of the anterior chamber in all cases presented, as is the case in most published reports of blunt ocular trauma.¹⁴⁻¹⁷ The average long-term visual acuity post-traumatic (closed globe) hyphema shows variability in the literature. In general, traumatic hyphema without other ocular complications has a good visual prognosis.^{3,18-20} Traumatic hyphema is commonly associated with corneal injury.¹⁶ The 11-year-old child had corneal oedema in addition to hyphema, which indicates the high velocity and force of the projectile hitting the eye. The child also had extramacular commotio retinae (oedema of the neuroretina). This is a notable finding, as the presence of posterior segment injuries in children with traumatic hyphema is associated with a worse visual

outcome.¹⁶ The extramacular location of the commotio retinae (as opposed to macular commotio) is associated with a favourable visual outcome,²¹ which explains the good visual outcome in our 11-year-old patient. Nevertheless, the ability of a Nerf gun projectile to induce commotio retinae is indeed worrying, as approximately a quarter of patients who develop macular commotio are left with a visual acuity of 6/9 (20/30) or worse.²¹

Ocular trauma can result in number of short-term to long-term complications. Angle recession is a term used to describe tearing of the circular muscle of the ciliary body from the longitudinal muscle. Angle recession has an approximate incidence of 71%–76% in post-traumatic hyphema.^{15 22} In one study, data from the United States Eye Injury Registry were obtained from a total of 6021 patients who experienced blunt ocular contusion. The 6-month incidence of developing post-traumatic glaucoma was 3.39%.²³ Of note, hyphema was found to have the highest independent association with post-traumatic glaucoma in this study, followed by lens injury and angle recession. In another cohort study of traumatic closed globe injury, the relative risk of developing chronically elevated intraocular pressure post-trauma at 6 months follow-up has been found to be significantly higher in the presence of traumatic hyphema or angle recession of more than 180°. ²⁴ The incidence of post-traumatic late onset (>6 months) secondary glaucoma is higher than early onset, at about 5%–10%.^{15 22 25} It is most commonly associated with angle recession.^{26 27} The involvement of only one clock hour of angle recession in 11-year-old child presented, and the normal intraocular pressure throughout follow-up, is the reason that the patient was deemed to be at no increased risk of secondary glaucoma. The adult patients did not attend the follow-up visits which were intended to check for the presence of angle recession. It is therefore unknown if this occurred in these two patients.

Sports in which the risk of ocular trauma is relatively high, such as squash ball, have seen an introduction of protective eyewear in the UK. This case series emphasises the seriousness of ocular injury from Nerf gun projectiles and calls into consideration the need for protective eyewear with their use. It also calls for reconsideration of the safe age limits for Nerf gun use in children.

As eye trauma due to Nerf gun injuries is not reported in the literature, there are no studies examining increased risk of ocular injury with certain types of Nerf guns or Nerf gun bullets (also known as darts). One of the patients in our case series reported that they eye was shot by a Nerf gun bullet that was purchased online. The price of 10 official labelled bullets was equivalent to the price of 100 unlabelled brand bullets. The bullets were sent to us by the patient. It was apparent on digital examination by the two authors of this case series (ie, non-professional examination) that there is an obvious difference in the firmness of the Nerf gun bullet head. The unlabelled brand by which the patient was injured was more firm. There is no evidence that had the patient been shot with the official Nerf gun bullets supplied by the gun supplier that the injury would have been less severe. It was not possible for the other two patients to confirm whether or not the eye was shot by a labelled or unlabelled Nerf gun bullet.

The reason given by the patient for buying large quantities of online unlabelled Nerf gun bullets is that they get consumed rapidly by children during their play. Hence, unlabelled bullets are more affordable. It is likely that this represents many households and thus the widespread availability of unlabelled or non-official bullets. The patient sent printouts of the Nerf gun bullets purchased. Numerous customer reviews of these bullets state that the tips are made of harder plastic, and hurt more,

especially at close range. A number of customers have written warnings to other customers about the harder less cushioned tips. The patient also reported that there are numerous online videos which show children how to modify their guns to make them shoot harder, faster and further distance. These videos have been viewed by the authors.

The aforementioned qualities of unlabelled Nerf gun bullets and/or techniques of Nerf gun modification may account for more significant eye injuries, but this case series is not able to give evidence for this. Two of the three patients were shot at close range (1 m and 2 m), and the third was shot at a distance of 8 m. As this is a case series of three patients only, no safe distance for avoidance of significant eye trauma can be established. It is important to note that the risk of having an eye injury with the Nerf darts also comes from the fact that a projectile can harm when it travels fast enough.

This case series encourages further studies to examine if there is a true increase in incidence of eye injuries secondary to Nerf gun injuries. This is especially important considering their prevalent use among children. It also encourages further exploration of modifiable causes of significantly traumatic eye injuries. Moreover, the use of protective eye wear is strongly encouraged, as the true scale of ocular injuries due to Nerf guns maybe under-reported. Finally, this case series highlights that there is a difference in the hardness of the range of Nerf gun bullets available for sale, which parents may not be aware of.

Patient's perspective

Patients were informed that a case series is being written up about patients presenting to accident and emergency with ocular injuries. This is an extract from a letter one of the adult patients wrote to us:

'If my household is typical, the availability of these products on ebay and amazon is likely the cause of the rise in problems you're having. The official products are about £7 for 10 vs £7 for 100 of a non-label brand. The nerf gun cartridges hold 10–20 darts each, and if my 2 children each have a friend over, 4 guns blazing, that's 80 darts at a time (excluding their backup cartridge for when the first one runs out mid battle, so in reality up to 160). And they get hovered up, lost outside and stood on and warped, so need to be replace at a pace. I can't afford the branded ones at the rate they use them...

...My child has pestered me with youtube videos that show kids how to modify their nerf guns to make them shoot harder, faster, further. I don't know how much this changes the gun's performance, my kids are too young, but it's possible older kids would do this'.

Learning points

- Nerf gun injuries can cause serious ocular trauma, as bullets travel at high speed.
- There is wide variability in Nerf guns available and hardness of Nerf gun bullets (also known as darts) available. Whilst there is no evidence this affects severity of ocular injury, parents and guardians should be aware of this.
- Protective eyewear may prevent potentially serious ocular damage.

Contributors MB wrote the case series report. SV edited the report and approved the final version.

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