Original Article

Traumatic Vitreous Hemorrhage in Children-Clinical Features and Outcomes

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Abstract

Purpose: To determine the clinical profile, causes, and outcomes of traumatic vitreous hemorrhage (TVH) in children (< 18 years of age).

Methods: Retrospective computer assisted chart review. 501 eyes of 464 children (103 females; 361 males) who presented with TVH between 2001 and 2012 were included. All children underwent a complete ocular and systemic examination and investigation. The etiology, visual, and anatomic results of pediatric TVH were the outcome measures.

Results: Median age: 12.27±4.51 years. 37 patients had bilateral VH; 43.24% of these were firecracker injuries. Commonest complaint was diminished vision (96.45%). Mean BCVA(logMAR) at presentation was 2.64±1.11 logMAR. Sticks (43.43%) and cricket balls (13.24%) were the commonest causes. Treatment included medical therapy (topical and/or systemic; 56 eyes), laser photocoagulation (34 eyes), and/or surgery (387 eyes). Mean final BCVA was significantly better (1.01±0.58 logMAR; P=0.011, Z test). Mean follow up in the closed and open globe trauma was 47±12.47 and 36.24±9.72 months, respectively.

Conclusion: TVH has significant implications in children. Firecracker injuries are notorious for bilateral VH. (***Eye Science 2014; 29:63-69***)

Keyword: firecracker; injury; vitrectomy

Introduction

Ocular trauma leading to vitreous hemorrhage often indicates significant damage to ocular structures, and can often be associated with poor visual outcomes. The prognosis becomes graver in children, as the incident may not be discovered immediately by parents, the child is unable to express visual problems (especially if the injury is monocular), inflammation is much more severe in children, and there is the threat of visual deprivation and amblyopia.

Additionally, blindness in children imposes a significant burden on society. Vitreous hemorrhage introduces further observation of the posterior segment in addition to that caused by the injury itself, and can lead to visual deprivation in young children, even if not associated with significant trauma to ocular structures[1].

Unlike the case for adults[2], trauma is the dominant cause of vitreous hemorrhage in children[1]. The visual prognosis is uncertain in most cases, and depends on the agent of injury, the extent of the injury, and any concurrent ocular damage. The topic has been studied previously[1,3]; however, cultural, regional, and social variations occur in different regions of the world. This mandates an adequate study of the factors involved in traumatic pediatric vitreous hemorrhage, so that adequate measures can be taken for prevention. The outcomes of any sort of intervention in traumatic vitreous hemorrhage also need to be studied in any given region, as only then can appropriate measures be formulated and directed towards correction.

The aim of this study was to determine the causes, clinical presentation, and anatomical and functional outcomes of traumatic vitreous hemorrhage in the pediatric population at a tertiary eye care center in India.

Methods and materials

The study consisted of a retrospective computer

DOI: 10.3969/j.issn.1000-4432.2014.02.001

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assisted database search and chart review of all patients aged less than 18 years with vitreous hemorrhage who presented to LV Prasad Eye Institute, Kallam Anji Reddy campus, Hyderabad between 1st Jan 2002 and 31st May 2012. Written informed consent was obtained for all subjects from their guardians/parents for the diagnostic and treatment procedures conducted and for possible use of data for academic purposes. The institutional review board approved the study, and all procedures adhered to the tenets of the Declaration of Helsinki.

Patients

Cases of vitreous hemorrhage secondary to non-traumatic causes (76 patients) and those with incomplete records (34 patients) were excluded. The chart review adhered to previously set guidelines, described in earlier publications[4].

Data collection

Data collected included demographics, laterality, presenting symptoms and signs (if the child was old enough to cooperate for appropriate history taking; if not, information about the onset of symptoms, possible causes and previously existing conditions, if any, was obtained from parents), details about the trauma including material and circumstances, the presenting corrected distance visual acuity, details of the examination procedure, additional investigations and systemic examination (if conducted), the cause (if evident), the treatment offered, associated systemic injuries (if any), the duration of follow up, and the final anatomical and visual outcomes. Information about the medico-legal nature of the injury was also collected from the charts. Special care was taken to look for non-accidental trauma by means of a detailed history and comprehensive examination, if the slightest doubt arose. Visual acuity was measured using the Snellen's chart and the results subsequently converted to logMAR chart and noted in log units. For children in the age range of 6 months to 4 years, Teller acuity charts were used and similarly converted to logMAR units. A comprehensive ocular examination was performed in all cases, including under short general anesthesia if the child was not cooperative. If media clarity was insufficient to permit adequate fundal examination, or when additional information (such as choroidal thickness or orbital status) was required, an ultrasound B scan was performed, unless the history and examination was suggestive of an open globe, in which case it was done after the primary repair (OPKO OTI Pvt. Ltd.). Trauma was classified as per the Pediatric Ocular Trauma Score[5]. Terminology used adheres to the Birmingham Eye Trauma Terminology System[6].

Treatment offered

Surgical intervention ranged from primary globe repair to combined buckling and vitreoretinal procedures for associated vitreo-retinal pathology. Non-surgical therapy consisted of observation, topical or systemic medical therapy, and/or laser photocoagulation. Frequent cycloplegic refractions and orthoptic and amblyopia therapy by part time occlusion were part of the management protocol. Wherever appropriate, optical rehabilitation was performed.

Statistical analysis

Data were analyzed using SPSS (v. 16, Chicago, IL), with special emphasis on the afore mentioned information. Statistical significance was set at $P < 0.05$. Descriptive statistics were used to determine the demographic data such as age, sex, and the kind of injury, and to determine the percentage of patients who had a particular finding. The paired *t*-test was used to determine whether the final corrected distance visual acuity was significantly better than the baseline corrected visual acuity. Outcome measures included the final visual acuity and anatomical results of intervention or observation in these cases.

Results

Demographics and descriptive data

A total of 464 cases (501 eyes) of traumatic vitreous hemorrhage in children under the age of 18 years were identified in the stated period after exclusion of patients with spontaneous vitreous hemorrhage, active retinopathy of prematurity, and coding errors. The general approach to a pediatric patient with vitreous hemorrhage has been described in one of our earlier publications[7].

The median age was 12.27±4.51 years, with a range of 2 months to 17.25 years. The mean duration to presentation from the traumatic incident was 3.14±1.2 days, with a range of 3 hours to 16 days. There were 103(22.20%) females and 361 (77.80%) males.

Thirty-seven patients had bilateral vitreous hemorrhage, and 16 patients (43.24%) of these patients had injuries due to firecrackers. The remaining patients had injuries from sticks (7), stones (5), and road traffic accidents (9).

Cause and modes of injury

Closed globe trauma was the most common cause of vitreous hemorrhage, occurring in 346 eyes (69.06%); the rest had open globe trauma. The most common presenting complaints were diminished vision (96.45%), pain (92.34%), and redness (91.45%). The mean baseline best corrected visual acuity in logMAR was 2.64±1.11 (approximated by counting fingers at 2m with a standard deviation of 20/200). Table 1 lists the modes of injury in our study patients. 73% of the injuries occurred in the evening or at night, with no particular day-wise or month-wise distribution. The only exception was firecracker injuries, where 90% occurred in and around October–November, during the Indian festival of lights (Diwali).

Table 1 Modes of penetrating injury in children

Causes	*n*=eyes(%)
Wooden/iron sticks	217(43.43%)
Cricket balls	66(13.24%)
Stones	60(12%)
Firecrackers	45(9.12%)
Arrows	25(5.12%)
Glass	5(1.05)
Fists	35(7%)
Thorns	10(2.12)
Needles	16(3.34)
Intraocular foreign body	7(1.56)
Accidents/falls	5(1.01)
Others(wire, bicycle handles)	10(2.02)

Follow up

The mean follow up in the closed globe trauma group was 47±12.47 months, with a range of 8 to 65 months.

Table 2 lists the associated ocular findings in all eyes. An ultrasound B scan was required in 321 eyes (64.07%). Table 3 lists the various findings as noted on the B scan in eyes with closed globe and open globe injuries.

Special notes

Overall, 64% of the open globe trauma cases included significant zone I and zone Ⅱ injuries, such as corneal lacerations and lens disruption, whereas only 28.42% of closed globe trauma cases had zone Ⅰ involvement secondary to globe rupture. Twenty-seven (7.8%) eyes with closed globe trauma and 11 (7.09%) eyes with open globe trauma had relative afferent pupillary defect in the affected eye; a neuro-ophthalmology consult was sought for these cases.

Table 2 Associated ocular findings in all eyes

	Open Globe Injuries	Closed Globe Injuries
Lid lacerations/burns/canalicular tears	24(11.94%)	49(16.22%)
Subconjunctival hemorrhage	109(53.96%)	302(100%)
Corneal/scleral tear/globe rupture	202(100%)	0(0%)
Self-sealing wound	35(17.3%)	0(0%)
Lens trauma	53(26.23%)	87(28.87%)
Retinal detachment	34(17.12%)	95(31.12%)
Choroidal detachment	42(21.02%)	91(30.15%)
Orbital injuries	2(0.8%)	25(8.3%)
IOFB	7(3.42%)	0(0%)

Table 3-1 B Scan findings at presentation

B scan results	Open Globe Injuries *n*=eyes(%)	Closed Globe Injuries *n*=eyes(%)
PVD present	19(9.57%)	39(12.91%)
PVD indeterminate/absent	124(61.38%)	138(45.69%)
Low to moderate density echoes	102(50.47%)	219(72.51%)
Lens disruption	72(35.64%)	51(16.88%)
Retinal detachment	22(10.89%)	90(29.80%)
Choroidal detachment	117(34.12%)	13(4.30%)
Optic nerve trauma	4(1.96%)	13(6.11%)
IOFB	4(1.15%)	0(0%)

Table 3-2 Age-based distribution of injuries

Age/Mode of Injury	Blunt	Penetrating
<1 year	23	8
>1-10 years	103	31
>10 years	220	116

Treatment offered

a) Medical method

Fifty patients (56 eyes) were given medical therapy (topical and/or systemic; 56 eyes). Of these 56 eyes, 50 had closed globe injury and 6 had puncture wounds, which were found to be self-sealing with no other associated signs of trauma or infection, and hence no repair was undertaken. Laser photocoagulation was required for retinal dialyses/breaks with or without lattices/subclinical detachment (34 eyes). Only 3 eyes with open globe injuries required laser photocoagulation and this was done after repair; the rest were cases of closed globe injury.

b) Surgical method

Surgical management was required in 387 eyes (265 eyes (76.58%) with closed globe and 149 (96.12%) with open globe injuries). The mean number of surgeries was 1.74±1.45 (range 1-4 surgeries) and the mean interval between surgeries was 15.73±11.26 days, depending on the type of surgery, the urgency of the procedure, the age of the patient, and patient compliance. Surgical interventions ranged from repair of corneal and scleral lacerations to vitrectomy, membrane peeling, endolaser treatment, and silicone oil injection. Of the 149 eyes with open globe injuries, 71 (45.08%) eyes had corneal lacerations and 64 (41.29%) had scleral lacerations. Seven eyes had a limbal laceration. Fifty-seven eyes with globe rupture or open globe injury required only a corneal or scleral wound repair; further surgery was either not required (31 (20.80%) eyes) or was deemed futile, given the extensive nature of the trauma (26 (17.44%) eyes). The remaining eyes with open globe injury or globe rupture received (in addition to primary wound repair) lens aspiration/lensectomy only (27 (18.12%) eyes) or vitrectomy with silicone oil injection with (52 (34.89%) eyes) or without encirclage (25 (16.77%) eyes). Twenty-three eyes with globe rupture received an encircling band in addition to primary repair. Seven children presented with clinical signs of endophthalmitis, and were treated with pars plana vitrectomy and intravitreal antibiotics with (3 eyes) or without (4 eyes) lensectomy. Seven patients with IOFB underwent IOFB removal in addition to pars plana vitrectomy with or without endolaser and silicone oil injection; in three of these eyes, a CT scan was required to confirm the presence of an IOFB as the USG B scan had failed to show it. One of these IOFB removal procedures was combined with orbital surgery as the patient also had concurrent IOFBs in the orbit. The mean time to surgical intervention in closed globe injuries was 3.12±1.36 days. The mean interval between surgeries was 27.42±10.28 days. Silicone oil removal, in eyes that required silicone oil injection, was done at 2 months after surgery unless complications necessitated earlier removal. Sixteen (6.03%) eyes with closed globe injuries underwent cryopexy for retinal dialyses, and another 9 underwent scleral buckling in addition to cryopexy. Thirteen eyes required cataract surgery only, and 5 of these underwent simultaneous vitrectomy for VH. Twenty-five (9.43%) eyes required lensectomy for dislocated or subluxated crystalline lens in addition to vitrectomy for VH. Twenty-three (8.67%) eyes required pars plana vitrectomy for persistent VH. The mean time to intervention in this group was 32.27±7.28 days. Ninety-seven eyes underwent pars plana surgery for retinal detachment.

Twenty-four eyes did not require any intervention, and all had closed globe injuries. These 24 eyes (analyzed as a subgroup) did not have treatable lesions and were followed up until the resolution of hemorrhage. Nine eyes had an associated choroidal rupture, while 7 eyes had Berlin's edema. The mean baseline visual acuity for these 24 eyes was 0.75±0.42 logMAR. The mean final visual acuity in this subgroup was 0.34±0.22 logMAR.

Prognosis

The mean final visual acuity was 1.01±0.58 log MAR and was significantly better than the baseline (P=0.011, Z test). Eyes with closed globe injuries (0.78±0.23) had a significantly better final visual acuity when compared to open globe injuries (1.37±0.53; P=0.029). The mean baseline visual acuity, although slightly better in closed globe injuries (2.32±0.61) as compared to open globe injuries (2.89±0.41), approached, but did not reach statistical significance (P=0.13).

Follow up (Open globe)

The mean follow up for patients in the open globe injury group was 36.24±9.72 months, with a range of 9 to 67 months.

Table 4 lists the major sequelae of closed and open globe injuries. Major sequelae after closed globe trauma were evidence of glaucoma (32 eyes), retinal edema (58 eyes, 19.20 %) and corneal scars of varying severity (99 eyes, 49 %) after open globe injuries.

Discussion

Trauma remains the first among all causes of pediatric vitreous hemorrhage[8]. Males appear to be par-

Table 4 Major sequelae of trauma

Major Sequelae	Open Globe Injuries	Closed Globe Injuries
Entropion/ectaeeopion/lid problems	14(6.93%)	37(12.25%)
Corneal scar (various degrees of severity)	99(49%)	24(7.94%)
Inoperable retinal detachment	23(11.38%;7 eyes had it since presentation)	20(6.62%; 5 eyes had it since presentation)
Resolved retinal edema	3(1.48%)	58(19.20%)
Choroidal/retinal scar	7(3.46%)	41(13.57%)
Optic pallor(of any degree)	6(3.11%)	32(10.59%)
Optic nerve trauma/avulsion	7(3.46%)	17(5.62%)
Phthisis	31(15.34%)	22(7.28%)
Eviscerated/enucleated	4(1.85%)	2(0.66%)

ticularly prone to this type of event, as reported in most early series, probably because of the more aggressive nature of male activities. The importance of traumatic vitreous hemorrhage is that it often precludes comprehensive posterior segment examination, and can therefore be a hindrance to decision making. In many cases, early intervention can result in reasonably good final visual acuity, although the appropriate timing is a matter of controversy.

The most common presenting complaint in the current study was decreased vision, similar to past reports[9,10].

Table 1 shows that the predominant cause of traumatic vitreous hemorrhage was accidental stick injury, typically sustained during play hours after school. That none of the cases were medico-legal in nature is suggestive, albeit not confirmatory, of the accidental nature of the trauma. A recently published study from India[12] found that injuries with cricket balls and sticks/rods are the commonest cause of traumatic vitreous hemorrhage, akin to what we report here. This is true for both open and closed globe injuries in that small sticks tend to penetrate the eye, whereas larger sticks (arrows) and rods result in a blow to the eye and subsequent closed globe trauma. An earlier publication from India found arrows to be the most common instrument responsible for open globe injuries; that study, however, was conducted in the northern regions of India[8], again raising awareness of cultural differences within our country As our results show, the associated ocular injuries are what determine the degree of visual disability, as well as whether the disability is transient or permanent. Overall, open globe injuries were more likely to result in poor visual outcomes. Finally, non-accidental trauma was apparently not a cause of hemorrhage in any of the patients; this was confirmed by repeated history taking along with detailed investigations to rule out associated systemic trauma whenever it was suspected.

Firecrackers appear to be particularly notorious for bilateral ocular injury, with approximately half of the bilateral traumatic vitreous hemorrhage cases due to firecrackers. Associated injuries are also particularly common in firecracker trauma[11].

Bilaterally blind children are handicapped very early in life, and impose a significant burden on society; hence, education regarding the safe and restricted use of firecrackers is of utmost importance. This is particularly critical since most of the injuries occurred around Diwali, the Indian festival of lights. Aggressive public education, commencing at least two weeks or so prior to the festival, might help to reduce the incidence of this type of trauma.

Despite numerous advances in ocular surgery, the final visual outcomes in traumatic vitreous hemorrhage are heavily dependent on whether permanent damage occurs to ocular structures such as the cornea or retina.

Unlike injuries reported in publications from Colombia[13], Canada[3] and the West Indies[14], most of the injuries in our series occurred outside homes, in the evening. The greater outdoor risk and the mode of injury, however, are similar to a study from Dalmatia County[15] as well as studies from Africa[16] and the Middle East[17], and probably represents cultural, socioeconomic, and environmental influences on the activities of children. This may stem from the greater exposure of Western children to potentially hazardous objects such as scissors and knives indoors, and lesser exposure to sticks or rods, whose use as toys may possibly be restricted in Western countries. Children in Western countries are also probably exposed to a more controlled environment while playing outdoors, and may not be permitted use of iron rods or arrows without protective gear. Laws governing the use of protection are generally deficient in developing countries like India, or are not enforced on a regular basis. Additionally, as stated in the article by Spirn[1], nearly a fifth of the open globe injuries had an IOFB, whereas IOFBs constituted around 5% of the total number of open globe injury cases in our series. This may have some relation to the mode of open globe injury; whereas, bottle rockets and motor vehicle collisions accounted for a majority of the open globe injuries in the series by Spirn[1], sticks and arrows were responsible for most of the open globe trauma in our series.

Twenty-three patients received vitrectomy for vitreous hemorrhage alone; the indication being persistence of VH and subsequent visual deprivation. We chose to operate as early as possible, given that these were pediatric patients.

Open globe trauma, though localized, leads to some degree of corneal scarring in almost all cases, should it involve zone 1. As can be seen from our results, nearly two thirds of the patients with open globe trauma had corneal involvement. Although open globe keratoplasty is an option[18], reports[19] about the success rates in post-traumatic eyes are conflicting and the visual outcomes are understandably limited by noncompliance, inflammation, and amblyopia.

Conversely, closed globed trauma generally involved zone Ⅱ and Ⅲ. If this results in foveal damage or complex retinal detachment, the outcomes can be poor, with no real cure at present. As can be seen in Table 4, irreversible damage to visual function, as occurs with optic nerve avulsions/atrophy or choroidal ruptures, is more common in closed globe injury cases. However, in most cases in our series, the degree of damage was not sufficient to affect useful vision completely. However, as is seen in our series, the injury in closed globe trauma appears to be less severe in most cases in that a sizeable number of patients in the closed globe trauma group regained useful vision. This is similar to the report by Spirn and associates[1]. This finding is also in tune with a study from Egypt[17].

The present study has the usual limitations of a retrospective study. In addition, since ours is a referral center, some element of Berkesonian (spurious) bias is always present[20]. Much research has been conducted in pediatric trauma in the past[21], as discussed before. However, this study provides us with the largest series thus far regarding the clinical presentation and outcomes of traumatic pediatric vitreous hemorrhage-a different and sometimes an additional problem-and brings to the fore numerous points unique to the Indian scenario (and that of the developing world in general) that stand in contrast with published literature, while reaffirming some of the findings that have been documented previously.

To conclude, traumatic pediatric vitreous hemorrhage, even in the amblyopic age group, often leads to only average visual gain because of the associated ocular injuries. Cultural differences between geographical regions influence presentation and-to an extent-the outcome. Legislative measures may be required to reduce the incidence of pediatric ocular trauma.

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