Original Article

Post-traumatic endophthalmitis in children

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Abstract

Purpose: To study the clinico-microbiological profile and evaluate the functional and anatomical outcomes of pediatric post-traumatic endophthalmitis (PPTE).

Methods: This was a retrospective interventional case series. All medical case records of patients diagnosed with PPTE over a 5-year period from January 2011 to December 2015 were reviewed. Data recorded was: age, sex, type of trauma, mode of injury, interval between trauma and presentation, treatment, follow-up duration and final functional and anatomical outcomes.

Results: Forty-one eyes of 41 patients diagnosed with PPTE met the inclusion criteria. There were 26 boys and 15 girls. The mean age at the time of presentation was 7.34 years (1month -16years). The median interval between trauma and presentation was 3 days (mean = 13.71 days; 1-240 days). The average follow-up period was 292.24 days (median 150 days; 30 1440 days). Injury with wooden stick (20,50%) was the most common mode of injury. Culture positivity was noted in 25(61%) cases. Staphylococcus aureus was the most common organisms identified on culture. Univariate analysis of independent variables was done using the Chi-square test showed patients with positive culture for gram-positive organisms had better anatomical (p=0.038) and functional outcomes (p=0.043). 35(85%) patients underwent vitrectomy along with intraocular antibiotics. Optimal anatomical and functional outcomes were noted in 23(56.1%) and 12(29.3%) respectively.

Conclusion: PPTE carries a significantly poor prognosis in terms of ocular integrity and visual function. PPTE is common in boys and often caused by vegetative matter. Staphylococcus aureus is the most common organism seen in PPTE. Early presentation following trauma and identification of gram-positive organisms have a better prognosis.

Key words: paediatric, trauma, penetrating, endophthalmitis, outcomes

Introduction

One of the most common causes of acquired unilateral blindness in children is ocular trauma (Mulvihili et al, 1997). Endophthalmitis is one of the devastating complications following ocular trauma accounting for 2%-7% of all penetrating injuries. Studies (Rishi et al,2016; Weinstein et al, 1979) have shown the incidence of pediatric post-traumatic endophthalmitis (PPTE) to vary from 8% to 60%. Rishi et al

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(2016) showed that more than 50% of cases were secondary to ocular trauma. Young children are especially susceptible to exposure to trauma. Children ≤ 5 years are at a particularly high risk for exposure to potentially traumatic events due to their dependence on caregivers. Negligence of the guardian and some behavioural conditions like attention deficit hyperactivity disorder are added risk factors (Bayar et al, 2015). In children, apart from the clinical signs and symptoms being different from that in adults, they also do not complain of pain or visual problems and hence risk delay in seeing a doctor. The spectrum of causative microorganisms in PPTE varies depending on the rural or urban location, environmental setting, type of injury and time delay from trauma to wound repair. Identification of causative microorganism is an important step in infective endophthalmitis management. Enterococcus fecalis and Streptococcus spp. were the most common organisms identified in children (Rishi et al,2016; Alfaro et al, 1995). This delay in presentation coupled with the high virulence of the organism are reasons for the poor prognosis in PPTE. Also, the need for repeated general anaesthesia for examination, injecting intraocular antibiotics and vitreoretinal surgery demands early and aggressive surgical management unlike in the adult cases. Even in cases with timely intervention, the visual outcome is dampened by factors like amblyopia and poor compliance to post-operative instructions and medications.

India is a large country with a dense population. In literature, there are very few reports discussing about traumatic endophthalmitis in children. Most Indian studies (Rishi et al,2016; Alfaro et al, 1995) on PPTE are reports from the southern states of the country with very few studies reported from the northern part. While interpreting the existing literature it must be kept in mind that there is a huge divide between the southern and northern states of the country in terms of accessibility to eye care, social, economic, literacy, environmental and cultural factors.

With this background, we intend to describe the aetiology, risk factors, microbiology, surgical management and study the correlation with the anatomical and visual outcomes of cases of traumatic endophthalmitis in children.

Materials and Methods

In this retrospective, single centre, interventional case series, children presenting with endophthalmitis due to ocular trauma at a tertiary eye care hospital in North India were included. Medical case records labelled with ICD-9 code 360.19 and diagnosed with endophthalmitis for the period from January 2011- December 2015 were retrieved from the hospital's integrated health care management system. Manual scrutiny of the case records was done and all patients diagnosed with traumatic endophthalmitis and age 18 years with minimum of 4 weeks of follow-up were included for the final analysis. The diagnosis of traumatic endophthalmitis was confirmed with the presence of exudates in the anterior and/or posterior segment following history of blunt or penetrating ocular injury. Prior institution review board approval was obtained for this study. The study was conducted according to the tenets of the declaration of Helsinki. A written informed consent was obtained from the parent/ guardian of all participating subjects.

In each patient, the following details were noted: 1) demographic data 2) type and mode of the ocular trauma as elicited by the parent/ guardian 3) presenting visual acuity by either Teller's acuity cards or Snellen's visual acuity charts wherever possible. 4) time interval between the trauma and presentation 5) surgical intervention carried out 6) microbiological organism isolated 7) duration of final follow-up 8) post-operative anatomical outcome and 9) post-operative visual outcome.

Every patient underwent complete ophthalmic examination including slit lamp bio microscopy and indirect ophthalmoscopy. Ultrasound B-scan was performed in all cases where primary globe repair was already done and in cases with suspected occult globe rupture and was deferred in cases with open globe injury at presentation. Radiological investigations like X-ray or computed tomography (CT) scan were done in cases with suspected intraocular foreign body.

Aqueous aspirate and/or vitreous biopsy were taken in all cases undergoing treatment under general anaesthesia. The decision for procurement of aqueous or vitreous sample was based on clinical judgment of predominant focus of involvement. In eyes where primary evisceration was advised, the eviscerated material was sent for microbiological analysis. Aqueous and vitreous fluid samples were to microbiology laboratory for analysis which included smear (Gram stain and KOH mount) and bacteriological and fungal culture and antibiotic sensitivity tests. First.1 ml), and dexamethasone (0.4 mg/0.1 ml). Patients were also treated with systemic steroids (1 mg/kg body weight) wherever the treating clinician felt inflammation to be significant. All patients with bacterial infections received parenteral Cefotaxime (50 mg/kg body weight in divided doses) and Gentamicin (57 mg/kg body weight/ day). Patients with proven fungal infections were treated with systemic ketoconazole (5-7mg/kg/day). All surgeries were performed under general anaesthesia. All patients were reviewed on day 1, day 6 and then 4 weeks after the treatment. Follow-up intervals were individualized depending upon the clinical status of the eye and at the discretion of the treating surgeon. Patients with a minimum follow-up duration of 30 days were included in the study analysis. The details at the final follow-up visit were noted as well. Optimal anatomical outcome (OAO) was defined as status of eye with no retinal detachment or pthisis bulbi at the last follow-up visit. Optimal functional outcome was defined as best-corrected visual acuity > 6/60 with OAO.

Statistical analysis

All statistical analyses were done using SPSS 22.0 for MacBook software (SPSS Inc, Chicago, IL, USA). Univariate analysis of independent variables was done using the Chi-square test with final anatomical and visual outcomes as the dependent variables. Multivariate analysis using logistic regression was planned to be carried out in case of statistical significance on univariate analysis. Statistical significance was considered if the p-value < 0.05.

Results

Of the 237 case records diagnosed with endophthalmitis for the given study period, 76 cases were identified in children with age < 18 years. Of these, 53(69.7%) patients were identified with endophthalmitis secondary to ocular trauma. Twelve eyes had follow-up shorter than 30 days and were excluded from the study. Out of the 41 eyes of 41 patients, 26(63.4%) were boys and 15(36.5%) were girls. Right eye and left eye were involved in 20(48.7%) and 21(51.2%) cases respectively. The mean age at presentation was 7.34 years (median - 7 years; range 1year -16 years). The median time interval of presentation following trauma was 3 days (mean 13.71 days; range 1-240 days). The average follow-up period was 292.24 days (median 150 days; range 30 1440 days). Table 1 shows the baseline characteristics of the patients. Injury with wood (20;48.7%) was the most common source of trauma. Ocular injury secondary to vegetative matter (25;60.9%) was more frequently seen than with non-vegetative matter (16;39%). Presenting visual acuity was light perception or worse in 24 (58.5%) eyes, whereas only 1 (2.4%) eye had visual acuity > 6/60. Children were uncooperative for visual acuity assessment in 16 (39%) eyes. The type

of ocular injury was penetrating in 39 (95.1%) eyes and blunt trauma in 2(4.8%) eyes. 2 (4.8%) patients underwent prior globe repair followed by treatment for endophthalmitis. Grading for the extent of the injury could not be done pre-operatively in most cases as the children were extremely un-cooperative for examination due to pain and symptoms. Children presented with traumatic cataract in 10 eyes, exudates in anterior chamber in 30 eyes, visible exudates in the vitreous cavity in 5 eyes, corneal abscess in 2 eyes, corneal tear (self-sealed, repaired and unrepaired) in 14 eyes, corneoscleral tear in 1 eye and intraocular foreign body (IOFB) in one eye.

Specimens sent for microbiological evaluation included aqueous aspirate in 10 (24.4%) eyes, vitreous aspirate in 30 (73.1%) eyes, eviscerated material in 1 (2.4%) eyes, corneal scrapings in 4 (9.7%) eyes and infected suture material in 1 (2.4%) eye. Positive culture results were noted in 25 (60.9%) eyes while culture was negative in 16 (39%) eyes. Vitreous fluid aspirate (22/30;73.3%) had a higher culture positivity rate compared to other ocular fluid samples sent to the microbiology laboratory. Causative microorganisms are listed in Table 2.

Amongst the bacteria, gram positive organisms were identified in 14 (34.1%) eyes and gram-negative organisms were seen in 8 (19.5%) eyes. Staphylococcus aureus (9/14; 64.3%) was the most common gram-positive organism, while Pseudomonas spp. (4/8; 50%) was the most common gram-negative organism isolated. Fungi was cultured in 4 (9.7%) eyes. Fusarium spp. was isolated in 2 (7.5%) eyes and one each of Candida spp. and Aspergillus spp. were isolated.

Thirty-five (85.4%) patients underwent 3-port vitrectomy along with intraocular antibiotics, 13 (31.7%) eyes underwent corneal tear repair, 3 (7.3%) eyes underwent therapeutic full-thickness penetrating keratoplasty and anterior chamber wash with intraocular antibiotics was performed in 3 (7.3%) eyes. Only one patient had an IOFB for which IOFB removal with intraocular antibiotics was performed. 6 eyes developed retinal detachment following vitrectomy. Four of the six eyes underwent retinal detachment surgery with silicone oil tamponade. At the final follow-up visit, 3 eyes had optimal anatomical outcome while one eye developed phthisis bulbi. The remaining 2 eyes who did not undergo retinal detachment surgery had poor anatomical and functional outcomes.

At the final follow-up visit, 12 (27.5%) eyes had a visual acuity > 6/60 while 29 (60%) eyes had PL or less vision. 18 (43.9%) of the 41 eyes had adverse anatomical outcome at the final follow-up visit; 2 (4.87%) eyes developed retinal detachment which were inoperable and 16 (39%) eyes developed phthisis bulbi.

Results

On statistical analysis, the mean time interval between the history of trauma and presentation was 17.69 ± 47.98 days (median = 5 days) in patients with adverse functional outcome and 4.08± 3.942 days (median 3 days) in patients with optimal functional outcome respectively. Univariate analysis of independent variables was done using the Chi-square test with final anatomical and visual outcomes as the dependent variables (table 3). Patients with positive culture for gram-positive organisms had better anatomical (p=0.038) and functional outcomes (p=0.043) compared to infection by gram-negative organisms or fungi.

Table 1: Baseline clinical characteristics of patients diagnosed with post-traumatic endophthalmitis

Clinical characteristics(n=41)		**Patient number (%)**
1) Age distribution	0-3 years	8(19.5)
	>3-12 years	28(68.3)
	>12-18 years	5(12.2)
2) Sex Distribution	Boys	26(63.4)
	Girls	15(39)
3) Laterality	Right eye	20(48.8)
	Left eye	21(51.2)
4) Source of injury	Organic	25(60.9)
	Inorganic	16(39.1)
5) Type of injury	Penetrating trauma	39(95.1)
	Occult rupture	2(4.8)
6) Presenting VA	>6/60	1(2.4)
	PL or less	24(58.5)
	Could not be assessed	16(39.1)
7) Mode of injury	Wood stick	20(48.7)
	Knife	1(2.4)
	Fire-cracker	1(2.4)
	Pen	3(7.3)
	Hypodermic needle	4(20)
	Finger nail	3(7.3)
	Pellet	1(2.4)
	Wire	3(7.3)
	Stone	1(2.4)
	Vegetative matter	2(4.8)
	Fall	2(4.8)
8) Specimen sent for microbiology	Aqueous aspirate	10(24.4)
	Vitreous aspirate	30(73.2)
	Scleral tissue/Eviscerated material	1(2.4)
	Corneal scrapping	4(9.6)
	Infected suture	1(2.4)
9) Culture results	Positive	25(60.9)
	Negative	16(39.1)
10) Treatment procedure	Vitrectomy + intraocular antibiotics	35(85.3)
	Corneal tear repair	13(12.5)
	Anterior chamber wash + intraocular antibiotics	3(7.3)
	Therapeutic keratoplasty	3(7.3)

11) Final functional outcome	>6/60	12(29.3)
	HM or less	23(56.1)
	Could not be assessed	6(14.6)
12) Final Anatomical outcome	Optimal anatomical outcome	23(56.1)
	Adverse anatomical outcome	18(43.9)
	Retinal detachment	2(4.8)
	Pthisis bulbi	16(39.1)

Table 2: Microbiological profile of patients diagnosed with post-traumatic endophthalmitis

Organism		**Number of eyes (%)**
Gram positive organisms(n=16*)	Staphylococcus Aureus	9(21.9)
	Bacillus	2(4.9)
	Diptheroids	1(2.4)
	Streptococcus viridians	4(9.7)
Gram negative organisms(n=8)	Klebsiella	3(7.3)
	Pseudomonas	4(9.7)
	Neisseria	1(2.4)
Fungus(n=4)	Aspergillus Flavus	1(2.4)
	Fusarium spp.	2(4.9)
	Candida	1(2.4)

*- in 2 cases, mixed growth was identified

Table 3: Post-traumatic endophthalmitis in 41 eyes of children: univariate analysis of risk factors with anatomical and functional outcomes

S. No	**Risk Factor**		**Adverse anatomical outcome**	**Optimal anatomical outcome**	**P-value**	**Adverse functional outcome**	**Optimal functional outcome**	**P-value**
1	Mean age		7.94±4.518	6.87±4.257	0.384	7.38±4.305	7.25±4.654	0.863
2	Time interval for presentation (days)		25.67± 60.067	4.35±3.537	0.233	17.64±47.980	4.08±3.942	0.266
3	Sex	Male	14	12	0.086	19	7	0.464
		Female	4	11		10	5	
4	Type of trauma	Vegetative	11	14	0.621	19	6	0.281
		Non-vegetative	7	9		10	6	
5	Cataract	Yes	6	4	0.208	7	3	0.622
		No	12	19		22	9	

6	Anterior chamber exudates	Absent	7	4	0.164	10	1	0.087
		Present	11	19		19	11	
7	Vitreous exudates	Absent	16	20	0.619	25	11	0.539
		Present	2	3		4	1	
8	Vitrectomy	Done	15	20	0.542	25	10	0.577
		Not done	3	3		4	2	
9	Gram-positive organisms	Absent	12	15	0.038	5	22	0.043
		Present	11	3		7	7	
10	Gram-negative organisms	Absent	19	14	0.5	10	23	0.569
		Present	4	4		2	6	
11	Fungi	Absent	23	14	0.03	12	25	0.235
		Present	0	4		0	4	

P< 0.05 is considered as significant.

Discussion

Our study is a retrospective, single centre, interventional case series. Of the 76 cases diagnosed with pediatric endophthalmitis in the 5-year period, 53 (69.7%) patients were secondary to ocular trauma. Twelve eyes had follow-up shorter than 30 days and were excluded from the study and data of 41 eyes were available for analysis. Older studies (Rishi et al,2016; Essex et al,2004; Das et al, 2005) from the Indian subcontinent have shown 51-69% of the pediatric endophthalmitis were due to ocular trauma. PPTE constituted 70% of all the cases of endophthalmitis in the current study. The incidence of trauma related ocular morbidity is relatively higher in the developing countries (Hoskin et al, 2016) as result of less strict laws relating to child care and increased parental negligence.

In our series, about 63% of the patients were boys. Alfaro et al (1995), Junejo et al (2010) and Rishi et al (2016) reported similar rates of 75%, 67% and 70% respectively in their studies. The mean of age of presentation that has been reported (Hoskin et al, 2016) was 10 years while PPTE was seen in slightly younger age group in our series. Injury with vegetative matter was more common than non-vegetative matter. Wooden stick injury followed by injury with hypodermic needle were the most common source of injury accounting to 48.8% and 9.8% of cases respectively in our study. This is very peculiar for cases which are reported from the subcontinent as most cases occur predominantly outdoors, in rural settings, due to unsupervised play and due to sharp pointed objects.

In our series, we found patients presenting early following trauma to the ophthalmologists had better anatomical and functional outcomes at the final follow-up visit. Presenting visual acuity had no correlation to the final outcome. This could be due to difficulty in visual acuity recording mainly due to the associated pain and clinical signs and symptoms making the child

extremely uncooperative for examination. Visual acuity recording in children with traumatic endophthalmitis is possible when the extent of trauma and infection is not very severe. However, early presentation, timely management and regular follow up would be helpful in avoiding an adverse visual and anatomical outcome in these cases.

Positive culture results were noted in more than 60% of cases in our study while it was about 45 % in a study reported by Rishi et al (2016). Also, high positive culture result rates have been noted in previous studies (Alfaro et al, 1995; Chhabra et al, 2006) from the western countries. Most of cases underwent primary management at our centre with no prior use of antibiotics. Only 2 cases underwent primary globe repair elsewhere with no use of intraocular antibiotics. This could explain the higher positive culture rate in our series.

In a study by Rishi et al (2016), Enterococcus fecalis was the most common causative organism while in our case series, Staphylococcus aureus (9 eyes) was the most common organism isolated. Gram-positive organisms were isolated in 14 eyes while gram-negative organisms and fungi were noted in 8 and 4 eyes respectively. Gram-positive organisms had better anatomical and visual outcomes. Infection with fungi showed poor anatomical and functional outcomes. Similar studies (Mieler et al, 1990; Alfaro et al, 1995) from the western population had also reported Staphylococcus aureus as the most common causative organism in traumatic endophthalmitis in the adult population while in children, Streptococcus spp. were identified in 55% of cases.

In our study, 85% of cases underwent therapeutic vitrectomy along with intraocular antibiotics. In our series, the median time interval between trauma and presentation was 3 days and most cases presented within 2 days of injury (mode =2). Our cases underwent primary therapeutic vitrectomy within one day following presentation to our centre. Hence, early diagnostic and therapeutic vitrectomy was done in our series of cases. This is in agreement with the recommendations of previous reports (Sternberg P and Martin D, 2001). Early vitrectomy reduces the microbiological load and helps in diffusion of intravitreal and systemic antibiotics within the eye. In our study, following therapeutic vitrectomy, about 50% of the cases had optimal anatomical outcome and 25 % of the cases showed improvement in visual acuity and had optimal functional outcome at the final follow-up visit. Iatrogenic retinal breaks occurred in 3 cases. In 4 eyes, dense exudates were plastered on the retinal surface and retinal details were not identified following vitrectomy. Retinal detachment was noted in 6 eyes following vitrectomy. Four of the six eyes underwent retinal detachment surgery. Silicone oil was used as endo-tamponade in these cases. At the final follow-up visit, 3 eyes had optimal anatomical outcome while one eye further progressed to pthisis bulbi. In 2 cases, the retinal detachment was inoperable and had poor anatomical and functional outcomes.

One of the major drawbacks of our study is the small cohort of cases with PPTE. We could have correlated the plausible predisposing factors for predicting the outcome in our series if we could have had a larger number of cases with PPTE. Nonetheless, our study describes in detail the demographic profile, varied clinical profile, etiological and microbiological factors and functional and surgical outcomes of children presenting with endophthalmitis secondary to ocular trauma to a tertiary eye care institution.

In conclusion, PPTE is commonly seen in boys and often caused by injury with organic matter. More than 50% of the culture positive cases were caused by gram positive bacteria; Staphylococcus aureus being the most common organism. Though the prognosis is guarded, with early presentation, timely diagnosis and management and strict and regular follow up,

these patients can at least be given ambulatory vision so that they are socially and economically less dependent. -line treatment consisted of topical antibiotics and mydriatic agents along with intravitreal antibiotic injections. Steroids were started based on initial smear reports and was individualized in accordance with culture results, and severity of signs and symptoms.

Treatment options included topical and systemic medications, intravitreal medications, and surgical management. All patients with clinically suspected or microbiologically proven bacterial infection were started on topical antibiotics and steroids and received intravitreal Vancomycin (1 mg/0.1 ml), Ceftazidime (2.25 mg/0.1ml).

References

Alfaro DV, Roth DB, Laughlin RM, Goyal M, Liggett PE (1995). Pediatric post-traumatic endophthalmitis. Br J Ophthalmol; 79: 888891.

Bayar H, Coskun E, Öner V, Gokcen C, Aksoy U, Okumus S et al (2015). Association between penetrating eye injuries and attention deficit hyperactivity disorder in children. Br J Ophthalmol; 99(8):1109-11.

Chhabra S, Kunimoto DY, Kazi L, Regillo CD, Ho AC, Belmont J, Maguire J, Vander J, Brown GC (2006). Endophthalmitis after open globe injury: microbiologic spectrum and susceptibilities of isolates. Am J Ophthalmol;142(5):852-4.

Das T, Kunimoto DY, Sharma S, Jalali S, Majji AB, Nagaraja Rao T et al (2005). Endophthalmitis Research Group. Relationship between clinical presentation and visual outcome in postoperative and posttraumatic endophthalmitis in south central India. Indian J Ophthalmol; 53(1):5-16.

Essex RW, Yi Q, Charles PG, Allen PJ. Post-traumatic endophthalmitis. Ophthalmology 2004;111: 20152022.

Hoskin AK, Philip SS, Yardley AM, Mackey DA (2016). Eye Injury Prevention for the Pediatric Population. Asia Pac J Ophthalmol (Phila); 5(3):202-11.

Junejo SA, Ahmed M, Alam M (2010). Endophthalmitis in pediatric penetrating ocular injuries in Hyderabad. J Pak Med Assoc; 60(7): 532535.

Mieler WF, Ellis MK, Williams DF, Han DP (1990). Retained intraocular foreign bodies and endophthalmitis. Ophthalmology; 97: 15321538.

Mulvihill A, Bowell R, Lanigan B O'keefe M (1997). Uniocular childhood blindness: A prospective study. J Pediatr Ophthalmol Strabismus;34:1114.

Rishi E, Rishi P, Koundanya VV, Sahu C, Roy R, Bhende PS (2016). Post-traumatic endophthalmitis in 143 eyes of children and adolescents from India. Eye (Lond); 30(4):615-20.

Sternberg Jr P, Martin DF (2001). Management of endophthalmitis in the post-endophthalmitis vitrectomy study era. Arch Ophthalmol;119: 754755.

Weinstein GS, Mondino BJ, Weinberg RJ, Biglan AW (1979). Endophthalmitis in a pediatric population. Ann Ophthalmol;11(6):935-43.