Original articles

Microbial contamination in open globe injury

Bhala S, Narang S, Sood S, Mithal C, Arya SK, Gupta V
Departments of Ophthalmology and Microbiology
Government Medical College Hospital,
Sector- 32, Chandigarh, India

Abstract

Introduction: Endophthalmitis is the most dreaded complication of ocular trauma and knowledge of the microbial contaminants is essential to start empirical antibiotic therapy.

Purpose: To determine incidence of contamination after open globe injuries (OGI) in our set-up and to identify the spectrum of microorganisms contaminating open globe injuries.

Material and methods: A prospective study including 50 consecutive eyes of open globe injury over a period of two years was conducted. Intra-operatively, 4 - 5 samples were taken from the inferior conjunctival sac and anterior chamber at the beginning and end of the open globe injury repair. Any abscised tissue or foreign body was also sent for culture sensitivity. A vitreous tap was taken from eyes with posterior segment trauma with signs of endophthalmitis.

Results: Microbial cultures were positive in13 eyes (26 %). The microbial spectrum included *Aspergillus species* in 45.6 %, *Alternaria* in 15.2 %, *Curvularia* in 15.2 %, *Staphylococcus aureus* in 7.6 %, *Bacillus species* in 7.6 %, *and Streptococcus pneumoniae* in 7.6 %. Of these 13 eyes, nine eyes developed clinically evident frank endophthalmitis during follow-up. Overall, endophthalmitis developed in 20 eyes (40 %). There was a significant association between the initial contamination and development of endophthalmitis ($p < 0.05$). 53 % of culture positive cases achieved ambulatory vision compared to 73 % of culture-negative cases.

Conclusion: Initial contamination was seen in 26 % of OGI cases. Aspergillus (fungus) was the commonest contaminant. There was a strong correlation between the initial contamination and development of endophthalmitis. Culture-negative cases had a trend towards better final visual outcome than culture-positive cases. Close follow up of cases showing contamination following OGI is recommended.

Key-words: endophthalmitis, open globe injury, microbial contaminants, Aspergillus

Introduction

Endophthalmitis is the most dreaded complication of ocular trauma. The incidence varies between 2.4 % to 18.42 % of all open globe injuries (Brinton et al, 1984), (Reynold et al, 1997). The incidence further doubles in rural set up (Meredith et al, 1999). Earlier series report cultures to be positive in 33 % of cases of open globe injuries from anterior chamber at the time of repair (Ariyasu et al, 1995). Recent studies show that the microbial spec-

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Address for correspondence: Dr Soniya Bhala, Department of Ophthalmology
Government Medical College Hospital
Sector-32, Chandigarh 160030 (INDIA)
Tel: +91-0172 – 2607707, Fax: +91 - 0172 -2607707
E-mail: soniya.bhala@gmail.com

trum is different for traumatic endophthalmitis in the developed and the developing countries (Kunimoto et al, 1999). The knowledge of the microbial contaminants in case of open globe injury is essential to start empirical antibiotic therapy in these cases. The present study was carried out to determine incidence of contamination after open globe injuries in our set up and to identify the spectrum of microorganisms contaminating open globe injuries.

Material and methods

This was a prospective study including 50 eyes of open globe injury that presented to our institute over a period of two years 2009-2010. The study was approved by the ethics committee of the institute and informed consent was taken from all the patients enrolled in the study. We excluded patients who had already received antibiotic therapy after sustaining the injury, or those who were on prolonged antibiotic therapy in that eye for any other ocular ailment, or if repair of open-globe injury had been done elsewhere. Eyes that were prephthisical at presentation and wherein primary repair was not possible were also excluded. A detailed history regarding the demographic profile of the patient, any systemic or ocular ailment in the past, treatment history, time of injury, cause and circumstance of injury was recorded. An attempt to assess visual acuity using Snellen's chart was made in all cases. A gentle and detailed slitlamp examination was carried out, with minimum disturbance to the globe, to ascertain the extent of open globe injury as per the 'International Ocular Trauma Classification System' (IOTC) (Pieramici et al, 1997). The presence of iris or vitreous prolapse; lens disruption; hyphema or vitreous hemorrhage; retinal detachment or other posterior segment abnormalities; retained intraocular foreign body; signs of infection at the time of presentation were recorded. For this study, 'endophthalmitis' was defined as the presence of hypopyon, vitritis, vitreous exudates, retinal periphlebitis (Narang et al, 2004). Before repairing, X-ray orbit antero-posterior and lateral view was done for all the cases to rule out radiopaque intraocular foreign body and ultrasound B scan was done in select cases by keeping the probe gently over the eyelid. The initial clinical findings were reconfirmed at the time of repair of open globe injury. The open globe injuries were repaired by any one of the authors under general anesthesia at the earliest after they reported to us. The patients were followed up for minimum of 3 months and signs of endophthalmitis were specifically looked for.

Technique of taking samples for culture

Intra-operatively 4-5 samples were taken from the affected eye, labeled and sent for microbial evaluation (Ariyasu et al, 1995). Sample A: The periorbital skin was cleaned with betadine solution and conjunctival culture sample taken by irrigating the inferior conjunctival sac of the eye to be operated with sterile normal saline under aseptic conditions and simultaneously 0.5ml to 1ml of this fluid was aspirated with the help of a sterile 2ml syringe.

Sample B: The eye was cleaned with 5 % betadine solution and 3 drops of 5 % betadine was instilled into the eye and kept for minimum of 5 minutes, thereafter the second sample of conjunctival culture was taken. This was followed by draping of the eye with sterile adhesive plastic.

Sample C: 0.1ml of aqueous humor was aspirated from the paracentesis site at limbus using a 26 gauge needle attached to 1cc syringe. In case of flat anterior chamber, 0.1ml of balanced salt solution was injected to reform anterior chamber after minimum intervention and sample was again withdrawn from the paracentesis site.

Sample D: 0.1ml of aqueous humor was aspirated from the paracentesis site at the end of surgery.

Sample E: Any abscised tissue or foreign body was sent in normal saline in a sterile test tube.

Sample F: Vitreous tap was taken in cases of endophthalmitis with guarded aspiration using a 24 G needle attached to 1 cc syringe, 4mm from limbus in phakics and 3mm from limbus in aphakics while visualizing the needle tip.

In the microbiology laboratory all the samples were immediately inoculated onto five culture media

(Blood agar, Chocolate agar, Thioglycollate broth, Brain heart infusion agar and Sabouraud's dextrose agar) and were incubated at 35° to 37°C in 5 % CO_2. The SDA media was incubated for at least 4 weeks, Thioglycollate broth for at least 1 week and rest all for 3 days before reporting them negative. A positive culture was defined as growth of same organism on one or more culture media along the culture streak or confluent growth on one solid media.

The open globe injury and foreign body was managed as per the standard guidelines. All the patients received at least 5 days of prophylactic oral levofloxacin (dosage of 500mg 12 hourly). Prophylactic intra-vitreal vancomycin 1mg and ceftazidime 2.25 mg were injected in all the eyes presenting for repair beyond 48 hours of sustaining trauma. Any case presenting with endophthalmitis or developing endophthalmitis during follow-up was subjected to a standard 3 port pars plana vitrectomy with intravitreal antibiotics at the earliest, if the corneal condition permitted posterior segment view. Final visual acuity was also recorded at last follow-up. Functionally successful outcome was defined as Snellen's visual acuity of more than or equal to 6/60 at the time of last follow-up examination. The 'chi square' test for independence tested the relationship of various baseline variables to culture positivity and final visual outcome in phase1 of analysis. In phase 2 of the analysis compound effect of variables significant in phase1 was analyzed using forward stepwise multivariate logistic regression (SPSS software).

Results

The study included 50 eyes of 42 males and 8 females with age ranging from 3 – 54 years (mean 19.66 $\pm$12.23 years). Twenty patients (40 %) were less than 13 years of age. Of the 50 patients, 40 (80 %) sustained injury in the rural set up and only 10 (20 %) sustained trauma in urban circumstances. The mode of injury included outdoor sports in 18(36 %) (home-made bow and arrow in 16 and cricket in 2), occupational injuries in 12 (24 %), agricultural activities in 7(14 %), household kitchen work in 4(8 %), road traffic accidents in 3(6 %), miscellaneous outdoor activities in 5 (10 %), particularly sheep horn in 1, assault in 3, table fan in 1. The cause of injury was unknown in one child (Table 1). Of the 50 eyes, 20 (40 %) presented within 24 hours of sustaining trauma, 18 (36 %), between 24-72 hours and 12 (24 %) beyond 72 hours of trauma. An attempt was made to assess visual acuity in all cases. The assessment of best corrected visual acuity was not possible at presentation in 10. Of the rest, as per IOTS grading, 1 eye had grade 1 visual acuity, 4 had grade 2, 3 had grade 3, 30 had grade 4 and 2 grade5 visual acuity at presentation. Thirty three eyes (66 %) had sustained zone1 injury, 10(20 %) zone 2 injury and 7 (14 %) zone 3 injury. Type A (globe rupture), type B (penetrating eye injury without intraocular foreign body), type C (penetrating injury with intraocular foreign body), and type D (globe perforation) was seen in 2, 33, 13 and 2 eyes respectively. None of the eyes sustained type E injury. Of the 13 eyes with foreign body, 6 (12 %) had metallic and 7(14 %) had non-metallic (wood, stone, glass) foreign body. Hyphema, hypopyon, iris prolapse, vitreous prolapse, lens injury and media clarity $\leq$ grade 4 was seen in 6, 10, 24, 8, 33 and 42 eyes respectively.

The initial cultures were positive in 13 eyes (26 %). The microbial spectrum included fungi (*Aspergillus species* in 45.6 %, *Alternaria* in 15.2 %, *Curvularia* in 15.2 %), *Staphylococcus aureus* in 7.6 %, *Bacillus* species in 7.6 %, *Streptococcus pneumoniae* in 7.6 % (Table 2). Of these 13 eyes, nine eyes developed endophthalmitis at some time during follow up (day 0 - day 16) and four eyes did not show any sign of infection at any point of time during their follow-up. Twenty eyes (40 %) developed endophthalmitis within 3 weeks (median 9 days) during follow- up. There was significant association between initial contamination (culture positivity from samples at time of repair) and development of endophthalmitis ($p<0.05$) (Table 3). None of the subsequent samples from eyes with endophthalmitis were positive, possibly, due to early administration of prophylactic broad-spectrum an-

tibiotic therapy in all open globe injury cases.

Functionally successful outcome (visual acuity of ≥ 6/60) could be achieved in 33 of the 50 eyes (66 %) and of these, visual acuity was ≥ 6/12 in 9 eyes (18 %). Age, sex, mode of injury, extent and type of injury, injury to repair delay, iris/vitreous prolapse, lens disruption, posterior segment complications, subsequent surgery did not show any correlation with culture positivity or visual results. Zone 1 injuries showed significantly higher incidence of endophthalmitis. ($p<0.05$). There were trends for better visual outcome in culture negative eyes but it did not achieve statistical significance (Table 4). Functionally successful outcome could be achieved in 6 (46.15 %) of 13 eyes showing microbial contamination and 27 of the 37 (72.97 %) eyes without any microbial growth from initial samples ($p>0.05$).

Table 1
Mode of injury

Cause of injury	Total eyes	Percentage
Sports	18	36
Bow and arrow	16	32
Other outdoor sports	2	4
Occupational	12	24
Agricultural	7	14
Household injuries	4	8
Road Traffic Accidents	3	6
Miscellaneous outdoor accidents		
Sheep horn	1	2
Assault	3	6
Table fan	1	2
Cause Unknown	1	2

Table 2
Culture results from samples of OGI

S No.	Samples							Organisms cultured
	A	B	C	D	E	F	Samples Culture+	
1	+		+	+			3	*Staph aureus*
2	+				+		2	*Staph aureus, Curvularia sp.*
3			+				1	*Alternaria sp*
4	+					+	2	*Staph aureus, Aspergillus niger*
5		+	+				2	*Aspergillus flavus*
6	+	+				+	3	*Aspergillus niger*
7		+				+	2	Streptococcal pneumoniae
8					+		1	*Curvularia sp.*
9		+	+	+			3	*Aspergillus flavus*
10				+	+	+	3	Alternaria species
11	+	+	+	+			4	Bacillus species
12	+		+	+			3	*Aspergillus niger*
13	+	+	+	+	+	+	6	*Aspergillus fumigatus*

Table 3
Association of culture positivity and post-traumatic endophthalmitis ($\chi^2=4.7167$, $p<0.05$)

Culture Results	Endophthalmitis (n=20)	No endophthalmitis (n=30)
Culture positive (n=13)	9(45 %)	4(13.33 %)
Culture negative (n=37)	11(55 %)	26(86.67 %)

Table 4
Visual outcome and culture results ($p>0.05$)

Final Visual Acuity	Culture positive Eyes (percentage)	Culture negative Eyes (percentage)
< 3/60	7 (53.4 %)	20(27 %)
≥ 3/60	6 (46.15 %)	27(72.91 %)

Discussion

Infection is the major concern in open globe injury. Despite empirical use of broad spectrum antibiotics the incidence of endophthalmitis stays high after open globe injuries. In the present study most of the trauma was sustained in rural background. The commonest cause of injury was by home-made bow and arrow in 32 % eyes. This sport is unique to the region and has been identified as major cause of injury in pediatric age group in earlier series from the region during festival days (Mukherjee et al, 1984; Vasnaik et al, 2002; Jaison et al, 1994; Narang et al, 2003; Saxena et al, 2002).

The contamination of open globe injuries by microorganisms was seen in 26 % cases which is comparable to 21 % -33 % reported in earlier series (Rubsamen et al, 1997). Notably despite wound contamination, cases do not develop endophthalmitis (Ariyasu et al, 1995; Rubsamen et al 1997). Probably, the development of endophthalmitis depends on the load of the innoculum . Moreover empirical use of broad spec-

trum antibiotics along with natural host defense mechanisms prevent subsequent clinical infection. In the present series endophthalmitis was seen in 40 % cases and many cases developed endophthalmitis despite negative initial cultures. This could be explained by low culture positivity due to time delay in transportation of samples to microbiology laboratory. The inoculation of sample within the operation theatre could have added to culture positivity (Gupta et al, 2003).

In our series fungi was the most common contaminant. The high incidence of endophthalmitis in our series could also be explained by the fact that there was no use of antifungal drugs empirically. Growth of fungi, bacillus and Pseudomonas have been associated with development of clinically significant endophthalmitis in earlier studies (Gupta et al, 2007).

Overall clinical endophthalmitis developed in 40 % cases in the present series, which is comparatively a very high figure. Of these, 45 % were contaminated at time of repair. There was a strong correlation between initial contamination and development of endophthalmitis ($p<0.05$). In a recent study of open globe injury in population more than 15 years of age, contamination was seen in 50 % eyes and clinical endophthalmitis was seen in 17 % eyes only. In their series empirical treatment was modified according to culture and sensitivity results in all contaminated cases(Gupta et al, 2007) . We did not modify treatment unless the case had clinical endophthalmitis. Some cases with culture positivity in the present series resolved without modifying the standard protocol. Thus body's own defence mechanisms are sufficient to fight contamination, possibly if the load of innoculum is less.

In the present study there were trends for better final visual outcome in culture negative endophthalmitis as compared to culture positive endophthalmitis eyes. However this did not achieve statistical significance. Earlier studies have also reported better outcome in culture negative cases (Gupta et al, 2007; Lieb et al, 2003; Affeldt et al, 1987). This also could be due to lower load of microorganisms leading to better outcome and lesser risk of endophthalmitis.

The limitation of the present study is that the ocular samples were not inoculated in operation theatre immediately but had to be transported to the laboratory which could lead to low culture positivity. Moreover all the patients were given prophylactic antibiotic cover which could be the reason for subsequent culture negativity in endophthalmitis cases.

Conclusion

Incidence of contamination is 26 % in open globe injury. There was a strong correlation between initial contamination and development of endophthalmitis. Culture negative cases had trend towards better final visual outcome. Close follow up of cases showing contamination following OGI is recommended.

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