

Paediatric post-traumatic endophthalmitis

D Virgil Alfaro, Daniel B Roth, Robert M Laughlin, Munish Goyal, Peter E Liggett

Abstract

Aims—A retrospective analysis of children with post-traumatic endophthalmitis was performed to determine if microbiological differences exist between this disease in the paediatric population compared with this disease in adults.

Method—Twelve cases of post-traumatic endophthalmitis in children were analysed to determine characteristics of this disease in youth. Patient ages varied from 18 months to 13 years; the mean age was 8 years. Gram positive organisms were isolated in eight eyes, Gram negative organisms from four eyes, fungus from one eye, and negative cultures in three eyes. The most common isolates were streptococcal species (56.6%) and staphylococcal species (22.2%). Vitrectomy was performed on eight (66.7%) eyes.

Results—Visual acuity of 20/200 or better was obtained in eight eyes (66.7%). Three eyes had vision less than 5/200. One eye developed phthisis bulbi. Nine (75%) patients were younger than 10 years of age, and six (66.7%) of these nine obtained a final visual acuity of 20/200 or better.

Conclusion—Useful vision can be obtained in children with post-traumatic endophthalmitis with early, aggressive treatment. The microbiology of paediatric post-traumatic endophthalmitis differs from adult disease with streptococcal species as the most common infecting organisms.

(*Br J Ophthalmol* 1995; 79: 888-891)

Post-traumatic endophthalmitis is a rare complication of penetrating eye injuries. It is thought that between 2.4%¹ and 7.4%² of eyes with ocular trauma develop endophthalmitis. In this disease process the ocular walls are breached, resulting in contamination of intra-ocular structures. Previous reports of post-traumatic endophthalmitis suggest that the type of injury and the nature of the infecting organism greatly determine the final visual outcome in these eyes.³⁻¹¹

Epidemiological analysis of previous reports of post-traumatic endophthalmitis suggests that this disease is more common in males (74-100%)^{2,4,8,11-13} with a mean age of 29 years.^{2,4,12,13} Post-traumatic endophthalmitis in children is rare; in reviewing one large series of patients, only 2.8% of post-traumatic endophthalmitis occurred in children of 18 years or younger.¹⁴ Weinstein and colleagues¹⁵ published a series on paediatric endophthalmitis in patients seen from 1965 to 1976. Their data were obtained before the widespread use of intravitreal antibiotics and pars plana vitrec-

tomy, however, making it difficult to draw conclusions in terms of contemporary management.

Herein, we report our experience with post-traumatic endophthalmitis in children with emphasis on microbiological differences that occur between this group and adults.

Materials and methods

We reviewed the medical records of 12 consecutive cases of post-traumatic endophthalmitis in patients 18 years and younger presenting to our institution. For each case we obtained the patient's age, sex, type of injury, initial visual acuity, vitreous culture results, treatment regimen, and final visual acuity.

Those patients presenting with post-traumatic endophthalmitis who had not had primary repair were immediately placed on intravenous cefazolin and gentamicin. During primary repair corneal wounds were repaired before conjunctival peritomy. Prolapsing subconjunctival uvea and/or subconjunctival blood, suggesting a scleral perforation, were attended to first. Conjunctiva and Tenon's capsule were locally dissected away from the wound. If vitreous prolapse was evident, a manual vitrectomy was performed using a dry cotton tip applicator and scissors. Scleral lacerations were uniformly repaired with 8.0 nylon suture. After repair of wounds involving the cornea and anterior sclera, a 360 degree peritomy was performed and the globe was explored. Routinely we first examined the four quadrants of the globe between recti muscles using the Schepens retractor and a cotton tip swab. Each of the recti muscles was then isolated and retracted to allow for visualisation underneath the muscle. If a scleral perforation was seen at the insertion of the recti muscle, the muscle was removed from the globe and then reinserted after repair.

Following repair of the globe, conjunctival, anterior chamber, and vitreous cultures were obtained. Anterior chamber taps were performed using a 30 gauge needle at the surgical limbus. Vitreous taps were obtained using a 23 gauge needle at the pars plana. Intravitreal injections of vancomycin 1.0 mg and amikacin sulphate 0.40 mg were given in all cases.

For all cases ocular fluids were plated on sheep blood agar, chocolate agar, thioglycolate broth, and Sabouraud's dextrose. Gram and Giemsa stains were performed on all scrapings.

In select cases a pars plana vitrectomy was performed to clear the ocular media and obtain ocular fluids for culture and examination. The decision to perform a pars plana vitrectomy was made by the attending vitreoretinal surgeon treating the patient. At our institution, criteria for performing a vitrectomy as an

Uniformed Services
University of the
Health Sciences,
Bethesda, and Yale
University School of
Medicine, New Haven,
USA

D V Alfaro
D B Roth
R M Laughlin
M Goyal
P E Liggett

Correspondence to:
D Virgil Alfaro, MD,
Uniformed Services
University of the Health
Sciences, 4301 Jones Ridge
Road, Bethesda, MD 20814-
4799, USA.

Accepted for publication
15 June 1995

Table 1 Details of post-traumatic endophthalmitis in children giving ages, source of injury, infecting organisms, treatment, and visual endophthalmitis

Case	Age/sex	Injury	Organism	Therapy	Time from injury to initial presentation	Final VA
1	18 mos/M	CL with screwdriver	<i>Staph aureus</i> , <i>Pseudomonas</i> spp	PPV, Abx	1 Day	HM
2	6/M	CSL	<i>Staph aureus</i>	PPV, Abx	Unknown	HM
3	6/M	CL	<i>Staph epidermidis</i> , streptococcal spp, <i>Candida albicans</i>	Abx	24 Days	20/30
4	6/M	SL	No growth	Abx	1 Day	20/30
5	7/M	CSL	<i>Bacillus</i> spp	PPV, Abx	Unknown	NLP
6	7/M	SL with dart	No growth	Abx	6 Days	2/200
7	7/M	SL with pencil	Streptococcal spp	PPV, Abx	4 Days	20/20
8	8/F	SL with pencil	Streptococcal spp	Abx	3 Days	20/30
9	9/M	CL with tweezers	<i>Propionibacterium acnes</i>	PPV, Abx	1 Day	20/200
10	13/M	CL with plastic	No growth	PPV, Abx	2 Days	20/80
11	13/F	CSL with metal	Streptococcal spp, <i>Neisseria</i> spp	PPV, Abx	1 Day	20/30
12	13/F	CSL with metal	Streptococcal spp, <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i>	PPV, Abx	1 Day	Phthisis

VA=visual acuity; CL=corneal laceration; SL=scleral laceration; CSL=corneoscleral laceration; NLP=no light perception; HM=hand motion detected; phthisis, phthisis bulbi; PPV=early vitrectomy; Abx=intraocular and systemic antibiotics.

adjunct to intravitreal antibiotics include but are not limited to: (1) vision less than 20/400, (2) vitreous opacification that prevents a funduscopic examination of the posterior pole.

Results

The majority of children suffering from post-traumatic endophthalmitis were male (nine of 12, 75%). The youngest patient was 18 months old and the oldest was 13 years of age. The mean age was 8 years. None of the cases was associated with intraocular foreign bodies. The time from injury to repair was 1 day to 24 days, with a mean time of 4.0 days.

The types of injuries included corneal, corneoscleral, and scleral lacerations. Bacterial and fungal cultures were performed on all eyes. Nine eyes (75%) were culture positive with four eyes (33.3%) growing out multiple organisms. Gram positive organisms were isolated from eight eyes, Gram negative organisms from four eyes, fungus from one eye, and cultures were negative in three eyes. The most common organisms isolated were streptococcal species (55.6%) and staphylococcal species (22.2%) (Table 1).

Systemic cefazolin and gentamicin were given to all patients. All 12 eyes received intraocular antibiotics; vitrectomy was performed on eight (66.7%) eyes as an adjunct to treatment. Final visual acuity of 20/200 or better was obtained in eight eyes (66.7%). Three eyes were salvaged, but resulted in vision of less than 5/200. One eye developed phthisis bulbi. Nine (75%) of 12 cases were younger than 10 years of age, and six (66.7%) of these nine cases obtained a final visual acuity of 20/200 or better (Table 1).

Discussion

The successful management of post-traumatic endophthalmitis depends upon a prompt diagnosis and treatment with intravitreal, broad spectrum antibiotics. Ideally, the drugs chosen for intravitreal use should provide coverage against the most likely infecting organisms. Clinically, it has been observed that some infectious pathogens cause disease more common in the paediatric population compared with their adult counterparts. For instance, *Haemophilus influenzae* is an important cause of pneumonia

in children but is less commonly responsible for the same disease in adults. This fact led us to question whether microbiological differences exist when comparing children and adults with post-traumatic endophthalmitis.

Several microbiological characteristics of our series suggest that paediatric post-traumatic endophthalmitis might differ from disease in adults. In the adult population *Staphylococcus epidermidis* and *Bacillus* species remain the two most common pathogens causing endophthalmitis after trauma. In the present paediatric series streptococcal species were found in 55.6% of the cases that were culture positive while both *Staphylococcus epidermidis* and *Bacillus cereus* were noted in only 12.5% eyes. In analysing only the paediatric patients from previous reports of post-traumatic endophthalmitis, it is clear that streptococcal species make up the predominant infecting organism: 66.6% were caused by Gram positive organism, with streptococcal (25.93%), staphylococcal (18.51%), and *Bacillus* (22.22%) species as the infecting agents (Table 2).

Cases of post-traumatic endophthalmitis in children are found in several previously published series of this disease (Table 2). The percentage of children in these studies varies from 2.8% to 58.3%, with a mean age of 10.4 years. Of 27 patients reviewed in aforementioned studies, 11 children (40.7%) were younger than 10 years of age, but only one (9.1%) of 11 obtained a final visual acuity of 20/200 or better. In our study, the mean age was 8 years old, 75% were younger than 10 years old, and 66.7% of children less than 10 years of age obtained a final visual acuity of 20/200 or better (Table 3).

The treatment of endophthalmitis has been the subject of recent controversy with some authors recommending the use of newer antibiotics for intravitreal use. All agree that the optimal treatment for endophthalmitis consists of the intravitreal injection of broad spectrum antibiotics, with or without vitrectomy as an adjunct to treatment. In the past most authors recommended intravitreal vancomycin in combination with gentamicin or amikacin. Several recent studies, however, suggested that intravitreal aminoglycosides may cause retinal infarction and that ceftazidime, a third generation cephalosporin, may be a more appropriate drug for obtaining Gram negative coverage.¹⁷⁻¹⁹

Table 2 Previously reported cases of paediatric endophthalmitis

Author	% Cases (No of children)	Age/sex	Organism	Treatment	Final visual outcome
O'Day <i>et al</i> ⁶	16.7 (1 of 6)	7/M	<i>Bacillus cereus</i>	IV Abx	NLP
Peyman <i>et al</i> ¹²	58.3 (7 of 12)	18/M	<i>Staph epidermidis</i>	PPV, Abx	20/20
		10/M	<i>Candida albicans</i>	PPV, Abx	20/60
		14/M	<i>Erwinia</i>	IV Abx	20/20
		18/M	<i>Staph epidermidis</i>	PPV, Abx	20/50
		4/F	Streptococcal spp	PPV	NLP
		4/M	Streptococcal spp	PPV	CF
Affeldt <i>et al</i> ¹³	25.9 (7 of 27)	14/M	<i>Peptostreptococcus</i>	PPV, Abx	20/20
		5/M	<i>Bacillus cereus</i>	IV Abx	enuc
		11/F	<i>Strep viridans</i>	IV Abx	LP
		3/F	<i>Klebsiella pneumoniae</i> , Enterobacter	IV Abx	NLP
		16/M	<i>Strep pneumoniae</i>	PPV, Abx	NLP
		8/M	<i>Clostridium</i> spp	PPV, Abx	NLP
		9/M	<i>Bacillus cereus</i>	PPV, Abx	LP
		6/M	<i>Aeromonas hydrophilis</i>	PPV, Abx	LP
Puliafito <i>et al</i> ¹⁴	2.8 (1 of 36)	12/M	<i>Pasteurella multocida</i>	Primary repair	20/40
Brinton <i>et al</i> ¹²	21.1 (4 of 19)	8/M	<i>Staph epidermidis</i>	PPV, Abx	20/20
		7/F	<i>Staph epidermidis</i>	PPV, Abx	3/200
		15 mos/M	<i>Strep viridans</i>	Primary repair	enuc
		10/M	Streptococcal spp	PPV, Abx	20/25
Ormerod <i>et al</i> ⁹	16.7 (1 of 6)	11/M	<i>Strep viridans</i>	PPV, Abx	20/200
Pflugfelder <i>et al</i> ¹⁰	16.7 (1 of 6)	16/M	<i>Cylindrocapsa tonkinense</i>		20/25
Boldt <i>et al</i> ⁸	16.7 (4 of 24)	15/M	<i>Bacillus</i> spp, <i>Pseudomonas maltophilia</i>		NLP
		12/M	<i>Bacillus</i> spp		enuc
		14/M	<i>Staph epidermidis</i>		enuc
		12/M	Diphtheroids		20/200
Hemady <i>et al</i> ¹⁶	14.3 (1 of 7)	15/M	<i>Bacillus</i> spp		enuc

Retinal necrosis, however, is a hallmark of endophthalmitis. Therefore, retinal infarction assumed to be secondary to aminoglycoside injection may in fact be secondary to the disease process. The role of ceftazidime in managing endophthalmitis remains undetermined, although preliminary data suggest that it has some advantages over the aminoglycosides for intravitreal use.

In the management of adult and paediatric post-traumatic endophthalmitis we recommend the following for intravitreal injection: vancomycin 1 mg and amikacin 400 µg. Although data from the present series reveal microbiological differences between adult and paediatric disease with streptococcal species as the most common infection organism in the latter group, vancomycin provides excellent coverage against these and other Gram positive microbes.

The role of pars plana vitrectomy in the management of post-traumatic endophthalmitis remains undetermined. Data from retrospective clinical studies suggest that vitrectomy in combination with antibiotics is not superior to intravitreal antibiotics alone in the management of post-traumatic endophthalmitis.²⁰ In these reviews, however, it is possible that those patients with more severe disease underwent vitrectomy while those patients with a milder form of disease were treated with intraocular antibiotics alone. In an animal model of endophthalmitis²¹ pars plana vitrectomy in combination with antibiotics was found to be

more efficacious than antibiotics alone in clearing of the vitreous cavity. In our study we performed para plana vitrectomy on 8/12 (67%) cases and obtained a visual acuity of 20/200 or better in 50% of cases. All eyes treated with intravitreal antibiotics only recovered visual acuity of 20/200 or better. Given the retrospective nature of our study it is impossible to draw definite conclusions regarding the benefit of pars plana vitrectomy. It is our clinical impression, however, that eyes with severe forms of post-traumatic endophthalmitis benefit from vitrectomy, as the procedure allows the surgeon to obtain a larger sample of vitreous for microbiological study and the vitreous cavity is cleared of inflammatory cells and bacteria that may be harmful to intraocular structures.

We evaluated separately cases of post-traumatic endophthalmitis in children under the age of 10 years. This subset of patients potentially may do worse compared with older patients, given the possibility of developing amblyopia. In our study nine (75%) of 12 cases were younger than 10 years of age, and six (66.7%) of these nine cases obtained a final visual acuity of 20/200 or better. Alfaro and colleagues²² recently published their results in a series of children under the age of 10 with penetrating ocular trauma to determine which factors determined visual outcome. They found that a visual acuity greater than 20/40 with stereopsis could be obtained in children only necessitating primary repair. Lenticular and vitreous injury treated with anterior or pars plana vitrectomy portended a poor prognosis in terms of visual acuity and stereopsis.

In conclusion, post-traumatic endophthalmitis in children appears to be caused more commonly by streptococcal species. Useful vision can be obtained through the use of broad spectrum intraocular and systemic antibiotics.

1 Forster RK. Endophthalmitis. In: Duane TD, ed. *Clinical ophthalmology*. New York: Harper & Row, 1981; vol 4: 1-20.

2 Brinton GS, Topping TM, Hyndiuk RA, Aaberg TM, Reeser FH, Abrams GW. Posttraumatic endophthalmitis. *Arch Ophthalmol* 1984; 102: 547-50.

Table 3 Previously reported cases of paediatric endophthalmitis

Author	% Cases (No of children)	Mean age (years)	No of children <10 years old	Sex	No of (%) eyes with final VA ≥20/200
O'Day <i>et al</i> ⁶	16.7 (1 of 6)	7.0	1	1 M	0 of 1 (0)
Peyman <i>et al</i> ¹²	58.3 (7 of 12)	11.7	2	6 M, 1 F	5 of 7 (71)
Affeldt <i>et al</i> ¹³	25.9 (7 of 27)	8.3	5	5 M, 2 F	0 of 7 (0)
Puliafito <i>et al</i> ¹⁴	2.8 (1 of 36)	12.0	0	1 M	1 of 1 (100)
Brinton <i>et al</i> ¹²	21.1 (4 of 19)	6.6	3	3 M, 1 F	2 of 4 (50)
Ormerod <i>et al</i> ⁹	16.7 (1 of 6)	11.0	0	1 M	0 of 1 (0)
Pflugfelder <i>et al</i> ¹⁰	16.7 (1 of 6)	16.0	0	1 M	1 of 1 (100)
Boldt <i>et al</i> ⁸	16.7 (4 of 24)	13.3	0	4 M	0 of 4 (0)
Hemady <i>et al</i> ¹⁵	14.3 (1 of 7)	15.0	0	1 M	0 of 1 (0)
Present study	100 (12 of 12)	8.0	9	9 M, 3 F	8 of 12 (66.7)

VA=visual acuity.

- 3 Davey RT Jr, Tauber WB. Posttraumatic endophthalmitis: the emerging role of *Bacillus cereus* infection. *Rev Infect Dis* 1987; **9**: 110-23.
- 4 Mieler WF, Ellis MK, Williams DF, Han DP. Retained intraocular foreign bodies and endophthalmitis. *Ophthalmology* 1990; **97**: 1532-5.
- 5 Irvine WD, Flynn HW, Miller D, Pflugfelder SC. Endophthalmitis caused by gram-negative organisms. *Arch Ophthalmol* 1992; **110**: 1450-4.
- 6 O'Day DM, Smith RS, Gregg CR, Turnbull PCB, Head WS, Ives JA, *et al*. The problem of bacillus species infection with special emphasis on the virulence of *Bacillus cereus*. *Ophthalmology* 1981; **88**: 833-8.
- 7 Schemmer GB, Driebe WT. Posttraumatic *Bacillus cereus* endophthalmitis. *Arch Ophthalmol* 1987; **105**: 342-4.
- 8 Boldt HC, Pulido JS, Blodi CF, Folk JC, Weingeist TA. Rural endophthalmitis. *Ophthalmology* 1989; **96**: 1722-6.
- 9 Ormerod LD, Paton BG, Haaf J, Topping TM, Baker AS. Anaerobic bacterial endophthalmitis. *Ophthalmology* 1987; **94**: 799-805.
- 10 Pflugfelder SC, Flynn HW, Zwickey TA, Forster RK, Tsiligianni A, Culbertson WW, Mandelbaum S. Exogenous fungal endophthalmitis. *Ophthalmology* 1988; **95**: 19-25.
- 11 Fisch A, Salvaret A, Prazuck T, Forestier F, Gerbaud L, Coscas G, *et al* and the French collaboration group on endophthalmitis. Epidemiology of infective endophthalmitis in France. *Lancet* 1991; **338**: 1373-7.
- 12 Peyman GA, Carroll CP, Raichand M. Prevention and management of traumatic endophthalmitis. *Ophthalmology* 1980; **87**: 320-9.
- 13 Affeldt JC, Flynn HW Jr, Forster R, Mandelbaum S, Clarkson JG, Jarus GD. Microbial endophthalmitis resulting from ocular trauma. *Ophthalmology* 1987; **94**: 407-13.
- 14 Puliafito CA, Baker AS, Haaf J, Foster CS. Infectious endophthalmitis. Review of 36 cases. *Ophthalmology* 1982; **89**: 921-9.
- 15 Weinstein GS, Mondino BJ, Weinberg RJ, Biglan AW. Endophthalmitis in a pediatric population. *Ann Ophthalmol* 1979; **11**: 935-43.
- 16 Hemady R, Zaltas M, Paton B, Foster CS, Baker AS. Bacillus-induced endophthalmitis: new series of 10 cases and review of the literature. *Br J Ophthalmol* 1990; **74**: 26-9.
- 17 Donahue SP, Kowalski RP, Eller AW, DeVaro JM, Jewart BH. Empiric treatment of endophthalmitis. Are aminoglycosides necessary? *Arch Ophthalmol* 1994; **112**: 45-7.
- 18 Campochiaro PA, Lim JJ, the Aminoglycoside Toxicity Study Group. Aminoglycoside toxicity in the treatment of endophthalmitis. *Arch Ophthalmol* 1994; **112**: 48-53.
- 19 Conway BP, Campochiaro PA. Macular infarction after endophthalmitis treated with vitrectomy and intravitreal gentamicin. *Arch Ophthalmol* 1986; **104**: 367-71.
- 20 Driebe WT, Mandelbaum S, Forster RK, Schwartz LK, Culbertson WW. Pseudophakic endophthalmitis, diagnosis and management. *Ophthalmology* 1986; **93**: 442-8.
- 21 Talley AR, D'Amico D, Talamo JH, Casey VJ, Kenyon KR. The role of vitrectomy in the treatment of postoperative endophthalmitis. An experimental study. *Arch Ophthalmol* 1987; **105**: 1699-702.
- 22 Alfaro DV, Chaudhry NA, Walonker AF, Runyan T, Saito Y, Liggett PE. Penetrating eye injuries in young children. *Retina* 1994; **14**: 201-5.