Paediatric post-traumatic endophthalmitis

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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.

Post-traumatic endophthalmitis is a rare complication of penetrating eye injuries. It is thought that between 2-4% and 7-4% of eyes with ocular trauma develop endophthalmitis. In this disease process the ocular walls are breached, resulting in contamination of intraocular 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.

Epidemiological analysis of previous reports of post-traumatic endophthalmitis suggests that this disease is more common in males (74-100%) with a mean age of 29 years. 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. W. Weinstein and colleagues 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 vitrectomy, 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
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, cor-
neoscleral, 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 staphy-
lococcal species (22-2%) (Table 1).

Systemic cefazolin and gentamicin were
given to all patients. All 12 eyes received
intracocular antibiotics; vitrectomy was per-
formed 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 diag-
nosis 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 infec-
tious 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 cul-
ture positive while both Staphylococcus epider-
midis 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%), staphy-
lococcal (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 anti-
biotics 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 com-
bination with gentamicin or amikacin. Several
recent studies, however, suggested that intra-
vitreal aminoglycosides may cause retinal
infection and that ceftazidime, a third genera-
tion cephalosporin, may be a more appropriate
drug for obtaining Gram negative coverage.17-19

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

VA=visual acuity; CL=corneal laceration; SL=scleral laceration; CSL=corneoscleral laceration; NLP=not light perception; HM=hand motion detected; phthis; Abx=intracocular and systemic antibiotics.
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. 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 endophthalmitis, 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 pars 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 amebopathy. 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 colleagues 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.

### Table 2 Previously reported cases of paediatric endophthalmitis

<table>
<thead>
<tr>
<th>Author</th>
<th>% Cases (No of children)</th>
<th>Age/sex</th>
<th>Organism</th>
<th>Treatment</th>
<th>Final visual outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>O'Day et al 6</td>
<td>16/7 (1 of 6)</td>
<td>7 M</td>
<td>Bacillus cereus</td>
<td>IV Ab x</td>
<td>NLP</td>
</tr>
<tr>
<td>Peyman et al 12</td>
<td>58-3 (7 of 12)</td>
<td>11-2</td>
<td>Staph epidermidis</td>
<td>PPV, Abx</td>
<td>20/20</td>
</tr>
<tr>
<td>Affeldt et al 13</td>
<td>25-9 (7 of 27)</td>
<td></td>
<td>Streptococcus spp</td>
<td>PPV, NF</td>
<td>CF</td>
</tr>
<tr>
<td>Puliafito et al</td>
<td>2-8 (1 of 36)</td>
<td>12-4</td>
<td>Bacillus cereus</td>
<td>IV Ab x</td>
<td>emuc</td>
</tr>
<tr>
<td>Brinton et al 12</td>
<td>21-1 (4 of 19)</td>
<td>8 M</td>
<td>Staph epidermidis</td>
<td>PPV, Abx</td>
<td>20/20</td>
</tr>
<tr>
<td>Ormerod et al 13</td>
<td>16-7 (1 of 6)</td>
<td>11 M</td>
<td>Streptococcus spp</td>
<td>PPV, Abx</td>
<td>20/200</td>
</tr>
<tr>
<td>Pflugfelder et al</td>
<td>16-7 (4 of 24)</td>
<td>15 M</td>
<td>Bacillus spp, Pseudomonas maltothila</td>
<td>PPV, Abx</td>
<td>NLP</td>
</tr>
<tr>
<td>Boldt et al 15</td>
<td>16-7 (4 of 27)</td>
<td>12 M</td>
<td>Bacillus cereus</td>
<td>PPV, Abx</td>
<td>20/200</td>
</tr>
<tr>
<td>Hemady et al 16</td>
<td>14-3 (1 of 7)</td>
<td>15 M</td>
<td>Bacillus cereus</td>
<td>PPV, Abx</td>
<td>20/200</td>
</tr>
</tbody>
</table>

VA=visual acuity.

### Table 3 Previously reported cases of paediatric endophthalmitis

<table>
<thead>
<tr>
<th>Author</th>
<th>% Cases (No of children)</th>
<th>Mean age</th>
<th>No of children &lt;10 years old</th>
<th>Sex</th>
<th>No of (%) eyes with final VA &gt;20/200</th>
</tr>
</thead>
<tbody>
<tr>
<td>O'Day et al 6</td>
<td>16-7 (1 of 6)</td>
<td>7 M</td>
<td>1</td>
<td>1</td>
<td>0 of 1 (0)</td>
</tr>
<tr>
<td>Peyman et al 12</td>
<td>58-3 (7 of 12)</td>
<td>11-2</td>
<td>6 M, 1 F</td>
<td>5</td>
<td>5 of 7 (71)</td>
</tr>
<tr>
<td>Puliafito et al 14</td>
<td>2-8 (1 of 36)</td>
<td>12-0</td>
<td>3 M, 1 F</td>
<td>2</td>
<td>4 of 50</td>
</tr>
<tr>
<td>Brinton et al 2</td>
<td>21-1 (4 of 19)</td>
<td>6-6</td>
<td>1 M</td>
<td>1</td>
<td>1 of 100</td>
</tr>
<tr>
<td>Ormerod et al 9</td>
<td>16-7 (1 of 6)</td>
<td>11-0</td>
<td>1 M</td>
<td>0</td>
<td>0 of 1 (0)</td>
</tr>
<tr>
<td>Pflugfelder et al 10</td>
<td>16-7 (1 of 6)</td>
<td>16-0</td>
<td>1 M</td>
<td>1</td>
<td>1 of 100</td>
</tr>
<tr>
<td>Boldt et al 8</td>
<td>16-7 (4 of 24)</td>
<td>12-3</td>
<td>4 M</td>
<td>2</td>
<td>4 of 50</td>
</tr>
<tr>
<td>Hemady et al 15</td>
<td>14-3 (1 of 7)</td>
<td>15-0</td>
<td>1 M</td>
<td>0</td>
<td>0 of 1 (0)</td>
</tr>
<tr>
<td>Present study</td>
<td>100 (12 of 12)</td>
<td>8-0</td>
<td>9 M, 3 F</td>
<td>8 of 12 (66-7)</td>
<td></td>
</tr>
</tbody>
</table>
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