1. Introduction

Traumatic endophthalmitis is a major cause of visual failure following open globe injuries and seemingly small injuries without obvious intraocular damage. Non-surgical trauma is involved in 25% of cases of endophthalmitis [1] and 2% to 7% of all penetrating injuries result in culture proven endophthalmitis [2, 3]. In spite of recent advances, overall prognosis remains poor. This is primarily due to infection with organisms of high virulence and delay in treatment. It is also observed that endophthalmitis is more commonly associated with cases involving intraocular foreign body (IOFB) than with cases without IOFB [2]. This article describes the microbiology, diagnosis, treatment and prognosis of endophthalmitis.

2. Microbiology

Traumatic endophthalmitis is unique in having high incidence of Bacillus species in particular B. cereus and associated with IOFB (Table 1). This organism produces enzymes and exotoxins that may result in loss of the eye over a short period of time. Clostridia are uncommon after trauma and may be associated with constitutional signs and symptoms. Fungal endophthalmitis is invariably caused by filamentous fungi. Fusarium solanae and similarly virulent species are associated with the worst prognosis. The microbiology of paediatric post-traumatic endophthalmitis differs from adult disease, with streptococcal species as the most common infecting organism [17].

3. Diagnosis

Traumatic endophthalmitis is often difficult to diagnose as the signs of the disease could be masked by the consequences of trauma. The mean interval between injury and onset of clinically detectable endophthalmitis is found to vary depending on the causative organism. The mean interval varies from as low as 4 days for bacterial cases to as high as 57 days for fungal cases [6]. Brinton et al. studied the injury-to-treatment interval [2] in a set of patients. In the case of failure in treatment, the mean injury-to-treatment interval was observed to be 3 days. The mean injury-to-treatment interval was higher in the case of successful treatment and was observed to be 8 days. This implies that prognosis is better with organisms of lower virulence, as in these cases endophthalmitis may develop more slowly and remain treatable for a longer time.

Clinical features of traumatic endophthalmitis include pain, proptosis, eyelid swelling, echymosis, elevated intraocular pressure, corneal edema, corneal ring abscess, anterior chamber reaction, hypopyon, lens damage, intraocular gas bubbles, vitreous exudates and retinal periphlebitis [12]. The presence of intraocular gas bubbles can be attributed to clostridia or B. cereus [18].

Table 1. Causative Organisms of traumatic and postoperative endophthalmitis (%)

<table>
<thead>
<tr>
<th>Traumatic</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.epidermidis</td>
<td>24</td>
</tr>
<tr>
<td>Bacillus species</td>
<td>22</td>
</tr>
<tr>
<td>Streptococcus species</td>
<td>13</td>
</tr>
<tr>
<td>Gram negative Organisms</td>
<td>11</td>
</tr>
<tr>
<td>Mixed flora</td>
<td>10</td>
</tr>
<tr>
<td>S.aureus</td>
<td>8</td>
</tr>
<tr>
<td>Fungi</td>
<td>8</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
</tbody>
</table>


Address for Correspondance: Tony’s superspeciality hospital. Aluva.
Ultrasound B scan examination is absolutely necessary to rule out IOFB, vitreous involvement and retinal detachment, in all cases where visualization of the posterior segment is obscured. A CT scan may also be necessary in cases of penetrating trauma where IOFB is suspected, to facilitate IOFB removal along with primary repair.

Diagnosis ultimately rests with identification of infectious organisms in the eye by appropriate cultures and stains. Vitreous and aqueous samples must be obtained in all suspect cases before therapy. Samples must be examined by gram stain. However, it is important to keep in mind that a negative result does not mean non-treatment, because a gram stain is positive only in 60% of culture positive cases. KOH mount and calcofluor mount of sample is also recommended for fungus. Aspirate should be promptly plated on blood agar, chocolate agar and thioglycolate broth and incubated at 37 degrees. A separate sabouraud’s plate for fungi and cooked meat medium should be incubated anaerobically. If one uses vitrectomy cassette fluid, concentrating the sample with membrane filtering system improves organism yield significantly. Approximately 64% of eyes with clinical endophthalmitis will display a positive culture. Repeat cultures may be performed 48-72 hours after initial therapy especially if initial results turn negative. Identification of organism using polymerase chain reaction (PCR) technique is useful, especially those from whom ocular samples prove to be culture-negative.

4. Treatment

1. Prophylaxis

The routine use of intravenous, periocular and topical antibiotics is indicated in virtually all cases of penetrating trauma, unlike in post-operative endophthalmitis. The breakdown of blood/ocular barrier by inflammatory processes in the setting of trauma improves antibiotic penetration and the actual intraocular drug level may even reach therapeutic levels. For gram-positive coverage, many isolates including S. epidermidis are uniformly sensitive to vancomycin and aminoglycosides (amikacin, gentamycin) are useful for gram-negative coverage. Ciprofloxacin may be an alternative in case of resistance.

Are intravitreal antibiotics necessary in all cases of globe rupture? Clinical experience suggests that most ocular lacerations without IOFB do not develop endophthalmitis. However, since such trauma is usually closely followed up, such an intervention can be attempted with the onset of definite signs and symptoms.

On the other hand, the presence of IOFB even without signs and symptoms merits intravitreal therapy, as there is a higher risk for endophthalmitis with organisms as virulent as B. cereus.

2. Active management

Vancomycin and amikacin/ceftazidime may be considered along with dexamethasone intravitreally as first line drugs against bacterial pathogens. For organisms like B. cereus, clindamycin with amikacin/ceftazidime is the most effective regimen. Anti-fungal therapy is usually initiated only after a positive culture or smear is obtained. Amphotericin B or voriconazole (if resistance) are the drugs used in such cases. A summary of the treatment is given in Tables 2, 3 and 4.

a. Vitrectomy

The advantages of vitrectomy include opportunity to obtain vitreous sample, clear ocular media, remove intraocular inflammatory and toxic products and facilitate greater drug diffusion. Vitrectomy is done as a primary procedure when endophthalmitis is associated with IOFB or retinal detachment. Driebe et al. reported 94% success rate with recovery of 20/400 vision with intraocular antibiotics only compared to a 50% success rate in the vitrectomy with antibiotics group. However, there was selection bias in this study, with vitrectomy being reserved for worst cases. Puliafito et al. found better visual results when vitrectomy was performed within first 24 hours than later. Raichand et al. recommended vitrectomy if eye was worse 24 to 48 hours after intravitreal antibiotic therapy. Pflugfelder et al. favored vitrectomy in association with intravitreal therapy for fungal cases. Forster showed that less virulent organisms like S. epidermidis responded well to intravitreal drugs alone, in comparison to more virulent organisms which ultimately needed vitrectomy. Disadvantages of vitrectomy include rapid clearance of intravitreal drugs, retinal breaks and retinal detachment. Nelson et al. noted a 21% incidence of retinal detachment in cases treated with vitrectomy.

b. Corticosteroids

Prophylaxis with steroids should be avoided as it may mask clinical signs and symptoms. A single intravitreal steroid injection may be considered as part of initial therapy especially for cases with severe inflammation. As a rule steroids are omitted in early management of traumatic fungal endophthalmitis but may be used in the setting of improved clinical course at a later stage.

5. Prognosis

The prognosis remains dismal in spite of recent advances. Factors include a delay in diagnosis, virulent spectrum of organisms and extent of associated injury. Presence of IOFB, retinal detachment and retinal toxicity in the setting of multiple intravitreal injections indicate poorer outcomes.

Ashok Nataraj - Post traumatic endophthalmitis
Recommended drug therapy in suspected traumatic endophthalmitis

**Intravitreal administration**

**Foreign body absent**
- Vancomycin 1 mg in 0.1 ml and amikacin 400 microgram/ceftazidime 2.25 mg in 0.1 ml

**Foreign body present**
- Clindamycin 250 microgram in 0.1 ml and amikacin 400 microgram/ceftazidime 2.25 mg in 0.1 ml

Dexamethasone 200 to 400 microgram may be considered for all cases with severe inflammation, but strict guidelines for intravitreal steroid use have not been determined.

**Subconjunctival administration**

**Foreign body absent**
- Vancomycin 25 mg and gentamicin 20 mg

**Foreign body present**
- Clindamycin 34 mg and gentamicin 20 mg

**Topical administration**

**Foreign body absent**
- Vancomycin 25 mg/ml drops administered q4h alternated with fortified gentamicin 14 mg/ml drops q4h/ Cefazolin 133 mg/ml/ceftazidime 50 mg/ml

**Foreign body present**
- Clindamycin 20 mg/ml drops q4h alternated with fortified gentamicin 14 mg/ml drops q4h/ ceftazidime 50 mg/ml

In cases with severe inflammation, prednisolone acetate 1% drops may be added after initiation of antibiotic therapy.

**Systemic administration**

**Foreign body absent**
- Vancomycin and aminoglycosides/ceftazidime

**Foreign body present**
- Clindamycin and aminoglycosides/ceftazidime

In cases with severe inflammation, prednisone may be given orally after initiation of antibiotic therapy.

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**Table 2: Recommended drug therapy in suspected traumatic endophthalmitis**

**Table 3: Recommended drug therapy for traumatic fungal endophthalmitis**

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Recommended drug therapy for traumatic fungal endophthalmitis *

**Intravitreal administration +**
- Amphotericin B 5 microgram in 0.1 ml.
  (Voriconazole 50 microgram in 0.1 ml[20] may be used in addition or given as a subsequent injection after failure of treatment with amphotericin B )

**Subconjunctival administration+**
- Miconazole 5-10 mg or amphotericin B 1 mg

**Topical administration+**
- Natamycin 5% or amphotericin B 0.15% or miconazole 1% drop q1h or Voriconazole 0.01mg/cc

**Systemic administration$**
- Ketoconazole 400-600 mg daily by oral administration. Voriconazole maybe tried in select cases.

These recommendations are derived partly from the article by Pflugfelder et al,* to which the reader is referred.

*Therapy for fungi is administered if the vitreous or aqueous specimen displays fungal elements on fresh smear or a positive fungal culture is obtained.

+Intravitreal injections are not repeated except in cases with a positive repeat culture or smear.

+Pflugfelder et al* reserve adjunctive subconjunctival and topical therapy for cases with significant anterior segment involvement.

$ Ketoconazole therapy appears to be well tolerated and may be used orally as sensitivities indicate. Systemic therapy with amphotericin B has a high incidence of toxicity, and its use in fungal endophthalmitis may be questioned. If intravenous therapy with amphotericin B/voriconazole is selected, careful attention to systemic toxicity is essential.
Guidelines for the management of suspected traumatic endophthalmitis

1. Prompt collection of vitreous and aqueous specimens for culture, stain, and smear in all suspected cases.
2. Evaluation for intraocular foreign bodies by CT, X-ray, and ultrasound where indicated.
3. Systemic, periocular, and topical antibiotic prophylaxis in all cases of globe laceration, rupture or penetration. These eyes may be carefully followed in a hospital setting without intravitreal drug therapy if a foreign body is not involved and signs of endophthalmitis are absent.
4. Intravitreal antibiotic therapy (in addition to systemic, periocular, and topical therapy) in all cases of suspected traumatic endophthalmitis and all cases of intraocular foreign body or soil-related injury.
5. Vitrectomy (often dictated by management of specific trauma such as intraocular foreign body) offered to cases of suspected traumatic endophthalmitis that display loss of red reflex, severe inflammation, or intraocular gas. Limited vitrectomy is preferred to minimize the risk of iatrogenic retinal detachment.
6. Consideration of intravitreal steroid therapy for cases with severe inflammation.
7. Repeat culture of vitreous and aqueous in 48 to 72 hours in cases with a positive initial culture and clinical deterioration following initial therapy.
8. Avoidance of repeat intravitreal injections, except in cases with a positive repeat culture or stain.
9. PCR in culture negative cases.

Table 4: Guidelines for the management of traumatic endophthalmitis [14]

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References

4. Affeldt JC et al, Microbial endophthalmitis resulting from ocular trauma, Ophthalmology,1987; 94: 407-413