Acute postoperative endophthalmitis (APE) is a devastating complication after intraocular surgery. Ominous signs of infection usually develop after 48 to 72 hours postoperatively. Initial intraocular signs and symptoms are pain, decreased visual acuity, afferent pupillary defect, hypopyon, corneal edema/infiltrate, fibrinoid anterior chamber response, vitreous inflammation, retinitis, and/or retinal periphlebitis. External signs of inflammation such as ciliary injection, chemosis, and lid edema may be present. In contrast, toxic anterior segment syndrome (TASS) is a sterile inflammatory reaction (Gram stain and culture negative) characterized by unusually severe, noninfectious, postoperative inflammation without vitritis within 24 hours of surgery, that is presumably induced by noninfectious toxic substances introduced into the eye during surgery. Onset in the immediate postoperative period (<48 hours) is usually presumed to be TASS, whereas a slightly delayed onset favors the diagnosis of APE.

Bacillus species are a group of ubiquitous, gram-positive, spore-bearing, endemic, soil-inhabiting rods commonly associated with food poisoning. Ocular manifestations include dacryocystitis, conjunctivitis, keratitis, and iridocyclitis. Endophthalmitis owing to Bacillus species is well-documented after penetrating ocular trauma ranging from 25% to 50% of all traumatic endophthalmitis cases. Endogenous endophthalmitis owing to Bacillus species has also been relatively well-defined. It has a fulminant course, with destruction of ocular structures within a few hours and heralds poor visual outcomes.
outcome in most eyes. Acute postoperative endophthalmitis owing to Bacillus species is rare, comprising only 0.7% of isolates in the Endophthalmitis Vitrectomy Study, and signifies breach in sterilization and aseptic precautions.7 We present a series of 6 eyes with acute fulminant postoperative B cereus endophthalmitis that had onset within 24 hours of surgery and despite early vitrectomy had dismal outcomes.

Methods

The clinical profile of all eyes with culture-proven B cereus endophthalmitis between January 2000 and May 2011 reported from the main hospital or any of our peripheral branches were reviewed. Being a retrospective study, Institutional Review Board/ Ethics Committee approval was not required for this study at our institution. This study adhered to the tenets of the Declaration of Helsinki. Patient demographics, namely, age, gender, type of surgical intervention with/without complications, time elapsed between surgery and the onset of signs/symptoms, best-corrected visual acuity at time of presentation, slit-lamp findings, intraocular pressure (IOP) by applanation tonometry, secondary surgical interventions, and final visual/anatomic outcomes were all recorded. All patients received intravitreal antibiotics at the time of initial treatment. Vitrectomy was employed based on the guidelines of the Endophthalmitis Vitrectomy Study.8 An undiluted vitreous sample was collected at the time of vitrectomy and the cytospinned smear was subjected to Gram staining and KOH mount. Specimens from intraocular fluids (both aqueous and vitreous) of patients with endophthalmitis were identified during the study period. All eyes had undergone uneventful phacoemulsification with intraocular lens implantation. Table 1 (available at http://aaojournal.org) shows a summary of demographic and clinical characteristics of the affected patients. All patients had a volatile onset and experienced excruciating pain in the operated eye associated with vomiting within a few hours of cataract surgery. They presented to our emergency services within the first 12 hours after surgery with very poor visual acuity (perception of light or worse), conjunctival congestion, and highly elevated IOP that could not be recorded accurately using Goldmann’s applanation tonometer in 4 cases (>70 mmHg). Patients were suspected to have surgery-related secondary glaucoma and were treated with oral azetazolamide (intravenous acetazolamide not being available in the country). However, within a few hours, lid edema, severe conjunctival congestion, chemosis, brownish discharge, and severe limbus-to-limbus corneal edema developed (Fig 1). There was no reduction of IOP despite maximal medical therapy. Slit-lamp evaluation revealed severe anterior chamber reaction with hyphema, fibrin, hypopyon, or brown exudates. Iris details were unclear and there was no appreciable glow of the fundus on indirect ophthalmoscopy. Ultrasound examination showed presence of dot vitreous echoes in all eyes. Acute fulminating postoperative endophthalmitis was suspected and patients received a combination of intravitreal vancomycin (1 mg/0.1 ml) and Ceftazidime (2.25 mg/0.1 ml) along with anterior chamber

Results

Six eyes of 6 patients with B cereus endophthalmitis were identified during the study period. All eyes had undergone uneventful phacoemulsification with intraocular lens implantation. Table 1 (available at http://aaojournal.org) shows a summary of demographic and clinical characteristics of the affected patients. All patients had a volatile onset and experienced excruciating pain in the operated eye associated with vomiting within a few hours of cataract surgery. They presented to our emergency services within the first 12 hours after surgery with very poor visual acuity (perception of light or worse), conjunctival congestion, and highly elevated IOP that could not be recorded accurately using Goldmann’s applanation tonometer in 4 cases (>70 mmHg). Patients were suspected to have surgery-related secondary glaucoma and were treated with oral azetazolamide (intravenous acetazolamide not being available in the country). However, within a few hours, lid edema, severe conjunctival congestion, chemosis, brownish discharge, and severe limbus-to-limbus corneal edema developed (Fig 1). There was no reduction of IOP despite maximal medical therapy. Slit-lamp evaluation revealed severe anterior chamber reaction with hyphema, fibrin, hypopyon, or brown exudates. Iris details were unclear and there was no appreciable glow of the fundus on indirect ophthalmoscopy. Ultrasound examination showed presence of dot vitreous echoes in all eyes. Acute fulminating postoperative endophthalmitis was suspected and patients received a combination of intravitreal vancomycin (1 mg/0.1 ml) and Ceftazidime (2.25 mg/0.1 ml) along with anterior chamber

Figure 1. Photomicrograph (original magnification, ×1000) showing Gram stain smear of the vitreous aspirate from a case of postoperative Bacillus cereus endophthalmitis. The white arrow points to pus cells and the black arrow points to bacillus.
paracentesis to reduce IOP. However, rapid worsening was seen clinically with development of corneal ring infiltrate and increase in conjunctival chemosis. Scleral necrosis with iris prolapse through the cataract surgical tunnel was also seen and extreme friability of the visible iris tissue was noted. In view of this, all patients underwent vitrectomy with intraocular lens removal and repeat intravitreal antibiotics. Furthermore, 3 eyes required additional operative procedures (Table 2; available at http://aaojournal.org). During vitrectomy, the vitreous was noted to be full of brownish exudates and no viable retinal tissue could be visualized. Extreme friability of uveal tissue was also noticed with iris tissue getting aspirated into the vitrectomy cutter with spontaneous ease.

Gram staining demonstrated plenty of gram-positive bacilli from the vitreous samples and *B cereus* was isolated in culture within 24 hours of inoculation. Table 2 shows a summary of antibiotic sensitivity of each isolate, need for secondary intervention, and final visual and anatomic outcomes in the 6 eyes. All the isolates were sensitive to vancomycin and ciprofloxacin. One eye required evisceration within 2 days of vitrectomy owing to rapid progression to panophthalmitis. Two eyes experienced extensive corneal infiltration that progressed rapidly to corneal melting, necessitating therapeutic keratoplasty. Five of the 6 eyes lost complete light perception at the end of treatment. Microbiologic investigations carried out revealed no *B cereus* growth on culture of viscoelastic, lactated Ringer’s solution and saline washings of phaco-probe. The routine operation theatre microbiologic surveillance monitoring showed that the colony counts were within acceptable limits. In 1 of the 2 water samples (collected from operation complex scrubbing area) cultured, *B cereus* was isolated in culture and genotypically identical to what was isolated from the patient’s intraocular specimen was grown.

**Discussion**

Acute postoperative endophthalmitis after cataract surgery is an emergency associated with considerable ocular morbidity and poor visual outcome. Usually, APE develops after 48 to 72 hours postoperatively, but when the onset is within the first 24 hours, one must differentiate APE with TASS. However, this distinction is often tricky and usually based on clinical judgment. In TASS, anterior segment inflammation is typically quite severe, usually resulting in hypopyon formation. Presence of diffuse limbus-to-limbus corneal edema with elevated IOP is also a feature of TASS. However, these features are a part of the clinical spectrum of APE as well, thus posing a challenge in its clinical differentiation from TASS. Holland et al. have splendidly enumerated clinical characteristics to distinguish TASS from APE. It is pertinent to note that clinical worsening of presumed TASS with topical steroids often alerts a clinician to the possibility of APE, as well.

In our series, all eyes with *B cereus* endophthalmitis had an onset in the immediate postoperative period, mimicking TASS. The presence of lid edema, conjunctival chemosis, brownish conjunctival discharge, hyphema, and extremely high IOP associated with severe ocular pain were the hallmark of this fulminant infection. High IOP at presentation, seen in our series, is uncommon in TASS and must alert toward an alternative etiology. Necrotizing endophthalmitis with rapid progression to involve the cornea and orbital contents despite early vitrectomy suggest the extremely high virulence of this organism.

Acute postoperative endophthalmitis owing to *Bacillus spp* is exceedingly uncommon, with sporadic reports describing variable clinical presentations and outcomes depending on the species involved. Table 3 shows a synopsis of studies that have reported postoperative endophthalmitis owing to *Bacillus spp*. Kunimoto et al. reported an incidence of 4% (5 eyes) of all postoperative endophthalmitis owing to *Bacillus* species. Roy et al. reported an outbreak of 14 cases (out of 42 operated eyes) of APE owing to *Bacillus* species in 1997. The source of infection was identified to be contaminated viscoelastic material. Out of the 14 cases, 13 were owing to *B circulans* and 1 was owing to *B brevis*. Three eyes had mild clinical presentation and were managed without vitrectomy, whereas 11 eyes had a fulminating presentation and required vitrectomy. All eyes presented fairly early in the postoperative period except 1. Thirteen eyes had successful resolution of infection after 1 month follow-up and only 1 eye that presented late with severe inflammation resulted in phthisis bulbi. The same authors presented data on recurrent endophthalmitis in the same cohort of 42 eyes exposed to the contaminated viscoelastic material. Four out of the initial 14 eyes with *Bacillus* endophthalmitis developed recurrent endophthalmitis after 1 year of initial treatment, whereas 1 patient developed chronic endophthalmitis 1 year after the cataract surgery. All eyes required repeated interventions with eventual removal of intraocular lens and capsular remnants in 4 out of the 5 eyes. All eyes retained relatively good best-corrected visual acuity at final follow-up (range, 20/25–20/50). Based on these results, the authors concluded that *Bacillus* endophthalmitis need not result in poor visual outcome. However, they did not encounter *B cereus* as the inciting cause in any of the cases.

Simini reported a cluster of APE after cataract surgery in which 4 out of the 8 operated eyes developed severe visual loss within 24 hours of cataract surgery, similar to our series. In this cohort, 2 eyes were eviscerated owing to necrotizing endophthalmitis and culture revealed *B cereus* as the causative organism. However, 2 eyes did not have a microbiologic diagnosis. Chan et al. have also reported a single case of *B cereus* endophthalmitis after cataract surgery. Their patient presented within 36 hours of cataract surgery with lid edema, purulent discharge, and hypopyon, and was eviscerated at day 7 after the onset of infection. Lalwani et al. reported endophthalmitis after advent of clear corneal incisions over a 10-year period (1996–2005) from a tertiary care center. They reported a single case of endophthalmitis owing to *Bacillus spp* in their study. The clinical details of this patient in particular were not provided by the authors. Hemady et al. reported 2 cases after glaucoma filtering surgery with milder clinical features and good visual outcomes. Miller et al. also reported 2 cases of APE, one occurring as delayed onset bleb-related endophthalmitis and another presenting after 8 days of cataract extraction. The former had poor visual outcome with no perception of light and the latter had a good visual outcome of 20/25 vision. Das et al. described the clinical profile of eyes with *Bacillus* endophthalmitis. Out of 31 cases described, 3 (10%) were attributable to APE after extracapsular cataract extraction; the rest of the cases were posttrau-
Ophthalmology Volume 120, Number 1, January 2013

Table 3. Summary of Published Reports on Postoperative Endophthalmitis Due to Bacillus species

<table>
<thead>
<tr>
<th>No</th>
<th>Authors</th>
<th>Organism</th>
<th>N</th>
<th>Initial Sx</th>
<th>Onset</th>
<th>Symptom</th>
<th>Signs</th>
<th>Vitrectomy</th>
<th>Interval to V†</th>
<th>2nd Sx</th>
<th>Final Visual Acuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Roy et al†4</td>
<td>B circulans(13)</td>
<td>14</td>
<td>PE+IOL</td>
<td>NA</td>
<td>Severe pain</td>
<td>Erythema, fibrin, hypopyon</td>
<td>11 eyes</td>
<td>41 hrs</td>
<td>Nil</td>
<td>1 – NPL, 13 – 20/40</td>
</tr>
<tr>
<td>2</td>
<td>Hemady et al†9</td>
<td>Bacillus spp</td>
<td>2</td>
<td>GPS (2)</td>
<td>4 yrs</td>
<td>Redness, watering</td>
<td>Congested bleb, AC fibrin</td>
<td>No</td>
<td>Nil</td>
<td>Nil</td>
<td>1 eye – 20/30, 1 eye – 20/50</td>
</tr>
<tr>
<td>3</td>
<td>Chan et al†7</td>
<td>B cereus</td>
<td>1</td>
<td>PE + IOL</td>
<td>36 hrs</td>
<td>Severe pain, discharge</td>
<td>Lid edema, chemosis, AC fibrin</td>
<td>Yes</td>
<td>48 hrs</td>
<td>Evisc</td>
<td>NPL</td>
</tr>
<tr>
<td>4</td>
<td>Chen et al†5</td>
<td>B circulans(2)</td>
<td>5*</td>
<td>PE + IOL</td>
<td>1 mo</td>
<td>Irritation</td>
<td>AC fibrin, KPs, PC cellular infiltrates</td>
<td>Yes</td>
<td>&gt;1 mos</td>
<td>ReV</td>
<td>20/20 – 20/50</td>
</tr>
<tr>
<td>5</td>
<td>Das et al†1</td>
<td>Bacillus spp</td>
<td>3</td>
<td>ECCE + IOL</td>
<td>1–10 days</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>Nil</td>
<td>Phthisis (1), PL (1), 20/100 (1)</td>
</tr>
<tr>
<td>6</td>
<td>Kunimoto et al†8</td>
<td>Bacillus spp</td>
<td>5</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>Lalwani et al†8</td>
<td>Bacillus spp</td>
<td>1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>Simini et al†6</td>
<td>B cereus</td>
<td>4</td>
<td>PE + IOL</td>
<td>24 hrs</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Evisc (2)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Miller et al†20</td>
<td>B cereus (1)</td>
<td>2</td>
<td>GFS (1)</td>
<td>16 mos &amp; 8 days</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
<td>—</td>
<td>NPL and 20/25</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Altiparmak et al†22</td>
<td>Bacillus cereus C trachomatis</td>
<td>4</td>
<td>PE + IOL</td>
<td>NA</td>
<td>Pain, blurry vision</td>
<td>Hypopyon, corneal abscess</td>
<td>Yes</td>
<td>Nil</td>
<td>—</td>
<td>Phthisis (2), CF (1), 20/200 (1)</td>
</tr>
</tbody>
</table>

AC = anterior chamber; APE = acute postoperative endophthalmitis; CF = counting fingers close to face; ECCE = extracapsular cataract extraction; Evisc = evisceration; GFS = glaucoma filtering procedure; hrs = hours; IOL = intraocular lens; KPs = keratic precipitates; mos = months; N = sample size; NA = not available; NPL = no perception of light; PC = posterior capsule; PE = phacoemulsification; PL = perception of light; ReV = repeat vitrectomy; Sx = surgery.

*Four recurrent and 1 chronic endophthalmitis; †Time elapsed between primary surgery and onset of symptoms; ‡Interval between cataract surgery and vitrectomy; §Large series describing microbiologic spectrum of acute postoperative endophthalmitis.

matic in nature. Two of the 3 cases presented in the immediate postoperative period (within 48 hours) and 1 case presented after 10 days of cataract surgery with coexistent fungal and Bacillus endophthalmitis. The former 2 eyes had very poor visual outcome, whereas the latter had a final visual acuity of 20/100. Altiparmak et al"22 reported a series of 4 cases of APE owing to coexistent infection with B cereus and Chlamydia trachomatis. Phthisis bulbii developed in the 2 patients in this series. Orsi et al"23 reported on an outbreak of postoperative B cereus endophthalmitis.

The presence of brownish exudates in the vitreous cavity owing to lysis of uveal tissue and rapidly progressive retinal disintegration can be attributed to release of various exotoxins by B cereus. Beecher et al"24 demonstrated the ocular virulence of toxins such as pure hemolysin BL and crude exotoxin of B cereus using in vitro assays and in vivo sterile endophthalmitis models. Ramadan et al"25 have also delineated the role of tumor necrosis factor alpha in experimental B cereus endophthalmitis pathogenesis.

It seems that infection owing to B cereus in the immediate postoperative period heralds poor anatomic and visual prognosis, whereas other Bacillus spp may have milder presentations with better outcomes. This is corroborated by the findings of the Endophthalmitis Vitrectomy Study, which states that onset of symptoms within 2 days of surgery, presence of corneal infiltrate, afferent pupillary defect, loss of the red reflex, and initial visual acuity of light perception only, were more common in eyes infected with “other” gram-positive organisms than in eyes infected with gram-positive, coagulase-negative micrococci. This was significantly associated with poorer visual outcome as well. However, initial visual acuity was more powerful than microbiologic factors in predicting visual outcome and favorable response to vitrectomy."26

In conclusion, our series demonstrates the importance of differentiating TASS from APE owing to B cereus, which has a very fulminant course. Explosive onset of pain and intractable glaucoma not responding to routine medical management must raise suspicion of B cereus endophthalmitis. In addition, presence of hyphema, lid edema, conjunctival chemosis, and diminished red reflex with features of TASS must arouse suspicion of APE. In this setting, it is advisable to perform an anterior chamber paracentesis for microbiologic evaluation (given that the IOP is not very high). On the contrary, presence of signs such as anterior chamber fibrin and corneal edema without much pain (i.e., signs out of proportion to symptoms) favors a diagnosis of TASS. Most eyes with APE owing to B cereus have very poor outcomes despite early vitrectomy. Because these are spore-forming organisms, they tolerate stringent sterilization techniques, mandating strict vigilance on a periodic basis to avoid an outbreak.

References


Footnotes and Financial Disclosures

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