Infective Endophthalmitis Caused by \textit{Bacillus cereus} after Cataract Extraction Surgery

Wai-Man Chan,\textsuperscript{1,2} David T. L. Liu,\textsuperscript{1} Carmen K. M. Chan,\textsuperscript{1} Kelvin K. L. Chong,\textsuperscript{1} and Dennis S. C. Lam\textsuperscript{1,2}

\textsuperscript{1}Department of Ophthalmology and Visual Sciences, Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, and \textsuperscript{2}Department of Ophthalmology and Visual Sciences, Chinese University of Hong Kong, Hong Kong Eye Hospital, Kowloon, Hong Kong, People’s Republic of China

We describe a 72-year-old Chinese man who developed fulminant \textit{Bacillus cereus} endophthalmitis 36 h after an uneventful surgery for cataract extraction. Clinical progression of disease was extremely rapid, in spite of early vitrectomy and intravitreal injection of antibiotics. Results of Gram staining showed gram-positive bacilli, and the culture was positive for \textit{B. cereus}. Endophthalmitis is rare after cataract surgery (cumulative probability within 1 year, \textasciitilde0.08\%), and cases caused by \textit{B. cereus} are even less common. The prognosis and plan of treatment are discussed.

\textit{Bacillus cereus} is a ubiquitous, gram-positive, endospore-forming rod. Occasionally, it can cause wound infection, gastrointestinal infection, pneumonia, meningitis, or septicemia [1–3]. Intraocular infections caused by \textit{B. cereus} are very rare, and most cases are related to trauma [4–7]. In several case series, vision outcomes were uniformly poor, with 75\%–91\% of patients experiencing a loss of light perception, eyeball evisceration, or enucleation [4, 5, 7]. We found only 2 culture-confirmed cases of postoperative \textit{B. cereus} endophthalmitis in the English-language literature [6, 8, 9]. Here, we describe an elderly Chinese man who developed relentlessly progressive \textit{B. cereus} endophthalmitis shortly after surgery for cataract extraction.

\textbf{Case report.} A 72-year-old Chinese man with an unrewardable medical history underwent an uneventful cataract extraction surgery on his left eye, which consisted of small corneal wound phacoemulsification and posterior capsule extraction surgery on his left eye, which consisted of small markable medical history underwent an uneventful cataract surgery for cataract extraction.

\begin{itemize}
  \item \textit{Bacillus cereus} was substituted for tobramycin. On the fifth day of infection, heavy growth of \textit{B. cereus} was seen on culture.
  \item Hourly treatment for acute postoperative infective endophthalmitis. Emergency vitreous biopsy and vitrectomy were performed, followed by intravitreal injection of 1 mg of vancomycin and 2 mg of cefuroxime [13, 14]. Hourly treatment with fortified topical antibiotics, including tobramycin (14 mg/mL) and cefuroxime (50 mg/mL), was begun. Examination of the vitreous sample showed gram-positive rods; neither mixed flora nor fungal hyphae could be seen. On the second day of infection, gram-positive rods grew on a culture of the initial vitreous biopsy specimen; these were suspected to be \textit{Bacillus} species. Accordingly, topical fortified vancomycin (50 mg/mL) was substituted for tobramycin. On the fifth day of infection, heavy growth of \textit{B. cereus} on the vitreous culture was seen. This organism was found to be sensitive to vancomycin.
  \item In spite of the aggressive treatments, there was increasing opacification and thinning of the cornea associated with features of impending perforation (figure 2). After a thorough discussion with the patient and his family, evisceration was chosen and was performed on day 7 of infection. Histopathologic examination of the left eye’s eviscerated contents showed acute supplicative inflammation, and no further bacterial growth was seen on culture.
  \item To search for possible sources of contamination, the patient’s postdischarge history was explored. Because there were no symptoms and signs of possible food poisoning or other foci of infection and because the patient denied that any obvious or gross soiling or contamination of the ocular wound by external agents had occurred, the chance that infection occurred by these routes was remote. Microbiologic samples were obtained from the autoclave oven and instruments. No
infecting organism, however, could be identified by either culture or PCR.

**Discussion.** Cases of *B. cereus* endophthalmitis generally are trauma related, and the involved eyes typically have poor vision outcomes [4–7]. A large proportion of patients (75%–91%) experience a loss of light perception, phthisis bulbi, evisceration, or enucleation [5, 7].

The cumulative probability of developing infective endophthalmitis within 1 year after cataract extraction has been estimated to be ∼0.08% [10]. Most cases of infective endophthalmitis were caused by gram-positive, coagulase-negative micrococci (70.0%), *Staphylococcus aureus* (9.9%), *Streptococcus* species (9.0%), and *Enterococcus* species (2.2%), as determined by the Endophthalmitis Vitrectomy Study (EVS) [11]. *Bacillus* species of all kinds as a cause of postoperative endophthalmitis has been reported only rarely (2 cases in 1918, 4 cases in 1981, 14 cases in 1996, and 5 cases in 1999) [6, 8, 9]. Compared with cases of endophthalmitis caused by trauma, postoperative endophthalmitis cause by *Bacillus* species other than by *B. cereus* did have a better vision outcome. Roy et al. [6] reported the largest case series of *Bacillus* endophthalmitis related to cataract extraction; 14 eyes were infected as a result of intraocular use of bacteria-contaminated viscoelastic material during the procedure. Only 7% of the infected eyes experienced a loss of light perception, and the authors concluded that cases of postoperative *Bacillus* endophthalmitis have a better prognosis than do cases of endophthalmitis caused by trauma, provided that vitrectomy is performed early. Most of the organisms grown in that series and in the others, however, were less-virulent *Bacillus* species, such as *Bacillus circulans*, *Bacillus brevis*, or *Bacillus subtilis* [6, 8, 12].

In our case, the organism grown was *B. cereus*, which is known to be the most virulent of the *Bacillus* species because of its unique exotoxins, including β-lactase and hemolysin BL (comprises a binding component, B, and 2 lytic components, L1 and L2), which are especially detrimental to ocular tissue [7, 13–15]. *B. cereus* rarely is the cause of the postoperative form of infective endophalmitis, and, to the best of our knowledge, only 2 culture-confirmed cases have been reported in the English-language literature [6, 8, 9].

In experimental animal models of induced *B. cereus* endophthalmitis, its destructive pathogenicity was clearly demonstrated histologically by the massive destruction of the corpus vitreous and rapid retinal necrosis [13–15]. The intraocular virulence of *B. cereus* is caused mainly by its secretion of exotoxins (tripartite hemolysin BL, phosphatidylcholine-preferring phospholipase C, and collagenase), the exuberant inflammatory response triggered by the potently immunogenic bacterial cell-wall components (peptidoglycan and teichoic acid), and the rapid intraocular migration of the organisms [13–15].

In the patient we describe here, disease activity followed the
typical pathway of traumatic \textit{B. cereus} endophthalmitis. The patient’s condition deteriorated rapidly within 36 h after an uncomplicated cataract operation. Because his level of visual acuity at presentation was light perception only, vitreous biopsy, vitrectomy, and intravitreal injection of antibiotics, followed by fortified topical antibiotics, were adopted as the emergency treatment, in accordance with the recommendations of the EVS [11]. In spite of these aggressive treatment strategies, the disease continued to progress rapidly, and evisceration had to be performed to prevent corneal perforation.

The main factors determining the vision outcome in endophthalmitis include virulence, the inoculum size of the infecting organisms, and, most important, the time lapse between onset of symptoms, diagnosis, and institution of appropriate treatment [16]. Ophthalmic surgeons have no control of the first 2 factors; therefore, timely treatment once the diagnosis is established is the only key to success [5, 6, 16]. \textit{Bacillus} species, \textit{B. cereus} in particular, are known to be deleterious to ocular tissue because of their virulence, which has been clearly demonstrated in vitro [13–15]. The introduction of early vitrectomy may help reduce the infective bacterial dose and the associated exotoxin inside the vitreal cavity [6]. In the largest case series on postoperative \textit{Bacillus} endophthalmitis, Roy et al. [6] postulated that the good vision outcome observed (1 case of phtisis bulbi among 14 cases of endophthalmitis) in postoperative \textit{Bacillus} endophthalmitis may be attributed to early vitrectomy, irrespective of EVS recommendations. One of their major arguments is that the applicability of the EVS recommendations in these circumstances may be significantly hindered, because only 1 of the 323 the microbiologic isolates used in the EVS was \textit{B. cereus} [12].

In the treatment of our patient, the early vitrectomy did not avert the ultimate poor vision outcome. Why did early vitrectomy fail in this case? There may be several possible explanations. First, the observation of Roy et al. [6] was based solely on more-benign \textit{Bacillus} species, such as \textit{B. circulans} and \textit{B. brevis}, instead of the more-virulent \textit{B. cereus} [6, 13–15]. Second, in experimental \textit{B. cereus} endophthalmitis, a significant inflammatory response as early as 6 h after infection has been observed in the presence of small initial numbers of organisms [13]. In other words, an early vitrectomy may effectively decrease the inflammatory reaction by removing the infectious load, provided that it is performed within some critical time threshold. This intervention window is extremely narrow for \textit{B. cereus}; in addition, there may be irreversible and progressive intraocular damage, as observed in our patient.

In conclusion, \textit{B. cereus} endophthalmitis after cataract extraction is a difficult intraocular infection to treat. Time is the key factor for success, and the importance of the patient’s awareness of and the clinician’s alertness to symptoms have to be emphasized [5, 6, 16]. It seems that a prompt recognition of the condition and early vitrectomy and administration of
antibiotics is the only way to salvage eye function in patients with acute, progressive Bacillus endophthalmitis. Demonstration of gram-positive bacilli in smears of samples from vitreous tapping may serve as a strong indication for prompt vitrectomy, because a high positive rate of 84% and a good correlation with culture have been demonstrated in a previous study. Adjunctive measures, such as intravitreal corticosteroid and ciprofloxacin therapy, are controversial and need to be tested further [17–19].

References