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Bordetella Holmesii: An Unusual Cause of Endogenous Endophthalmitis in a Patient With Sickle Cell Disease

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Abstract

Purpose: This case report describes a rare organism causing endogenous endophthalmitis in a patient with sickle cell disease. **Methods:** A case report was conducted. **Results:** A 41-year-old man with sickle cell disease presented with acute onset of blurry vision of the right eye. His visual acuity was counting fingers in the right eye and 20/20 in the left eye. He had ophthalmic findings of hypopyon and vitritis in the right eye, consistent with endophthalmitis. He was treated with intravitreal and systemic antibiotics. Vitreous cultures grew *Bordetella holmesii*. His visual acuity at follow-up visits improved to 20/40 in the setting of improved vitritis. **Conclusions:** This is the first case describing *B holmesii*, a rare causative organism of endogenous endophthalmitis, in a patient with sickle cell disease. More studies are needed to improve the early detection and treatment of this unusual organism.

Keywords

endophthalmitis, endogenous endophthalmitis, *Bordetella holmesii*, sickle cell disease

Introduction

Bordetella species are an uncommon cause of endophthalmitis. *Bordetella holmesii*, a subspecies identified in 1995, has been recognized as an emerging pathogen in patients with sickle cell disease (SCD).[1,2] Most studies to date involving this organism are described in respiratory and bloodstream infections, with several reports of endocarditis, pericarditis, septic arthritis, and meningitis.[1,3] The purpose of this study is to report the first case of endogenous endophthalmitis secondary to *B holmesii* in a patient with SCD.

Methods

Case Report

A 41-year-old African American man with a medical history of SCD (hemoglobin SC), pulmonary embolism, and avascular necrosis of the hips presented to a community hospital for fevers, chills, and generalized malaise and was found to have bacteremia secondary to *B holmesii*. He was treated with intravenous ceftriaxone. The workup to identify the source of infection included normal findings from chest radiography and computed tomography of the abdomen and pelvis along with normal findings from a urine analysis and culture. Once his symptoms resolved, he was transitioned to oral cefuroxime to complete a 14-day antibiotic course. Three weeks later, he presented to our emergency department with a 24-hour history of sudden onset eyelid edema, pain, redness, floaters, and photophobia in the right eye. He denied a history of ocular surgery, trauma, or any systemic symptoms such as fevers, chills, cough, or generalized malaise.

On ophthalmic examination, his visual acuity was counting fingers at 1 foot in the right eye and 20/20 in the left eye. Intraocular pressure was 16 mm Hg in both eyes, and there was no motility defect and no afferent pupillary defect. A slit-lamp examination of the right eye showed diffuse conjunctival injection. The anterior chamber was noted to have grade 4+ cells and a layered 1.0-mm hypopyon. The fundus examination of the affected eye was obscured by vitritis, and a B-scan ultrasonography revealed hyperechoic vitreous debris occupying more than 50% of the vitreous cavity with no evidence of retinal detachment or abscess. The fundus examination of the unaffected left eye showed regressed neovascularization in the periphery and a single sunburst lesion inferotemporally. He underwent a vitreous tap and was treated with intravitreous injections of vancomycin (1 mg/0.1 mL) and ceftazidime (2.25 mg/0.1 mL).

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During his admission to the infectious disease service, a more extensive medical workup was completed. The physical examination did not reveal any skin infections. Imaging included normal observations from chest radiography, transthoracic and transesophageal echocardiograms that showed no vegetations, and a computed tomography of the abdomen and pelvis that revealed an atrophic and calcified spleen but no other concerning intra-abdominal lesions or abscesses. Laboratory workup included normal findings from a urinalysis with urine culture and normal levels of angiotensin-converting enzyme, and serologies were negative for rapid plasma reagin, HIV, Quantiferon Gold (Qiagen), and toxoplasmosis immunoglobulin M and immunoglobulin G. Test results for herpes simplex virus and varicella-zoster virus polymerase chain reaction of the vitreous fluid were normal. Although results from blood cultures were negative, vitreous fluid cultures grew *B holmesii* 5 days later.

He was started on topical treatment with prednisolone acetate 1% and atropine. He was empirically started on intravenous vancomycin and cefepime but was switched to meropenem once the cultures resulted. Visual acuity in the right eye improved to 20/100 at 2 weeks and 20/40 at 5 weeks. No chorioretinal lesions were observed once a view of the fundus was clear.

Results

B holmesii is a gram-negative coccobacillus that was first described in 1995. However, the first case ever recorded was in 1983 by the Centers for Disease Control and Prevention in a 37-year-old man with asplenia.[2] To date, the prevalence of this disease is limited, but several studies identified this organism in 0% to 29.3% in nasopharyngeal swabs of patients with pertussis-like symptoms.[4] It has primarily been identified in immunocompromised patients such as young adults with sickle cell anemia and functional or anatomic asplenia.[5,6] *B holmesii* is mainly seen in respiratory and bloodstream infections, with a few case reports of endocarditis, pericarditis, septic arthritis, and meningitis.[3,4] To our knowledge, this is the first case in the English-language literature to describe endogenous endophthalmitis secondary to *B holmesii*.

Endogenous endophthalmitis is defined as a hematogenous spread of microorganisms from a distant site in the body to the inner layers of the eye and is associated with significant vitreous inflammation.[7] The infection spreads to the posterior segment vasculature, through the blood-ocular barrier, and disseminates through the choroid and retina into the vitreous cavity and anterior chamber.[8] One of the hallmark clinical findings on examination is significant vitritis along with conjunctival injection and hypopyon, as seen in our patient.[7] To our knowledge, only 4 case reports describing endogenous endophthalmitis in SCD have been published.[9-12] In 2 cases, ocular cultures were obtained, but gram stain showed no organisms and cultures remained negative.[10,11] In our case, findings from vitreous cultures were positive, but the results did not appear until after 5 days. Treatment of this rare condition requires the administration of systemic and intravitreal antibiotics, which are usually tailored toward the causative organism. To date, there is no set guideline on when to administer intravitreal antibiotics, but studies have shown that early intervention leads to better visual prognosis.[13] In our patient, intravitreal antibiotics were injected within 24 hours from the onset of symptoms, which may have contributed to good visual outcomes.

Although the source of the infection could not be identified, the predisposition for *Bordetella* is likely a consequence of SCD. In the largest published case series describing *B holmesii* bacteremia cases over a 17-year period, the Centers for Disease Control and Prevention found that 22 patients (85%) were functionally or anatomically asplenic at the time of infection, and 10 of these patients (38%) had SCD.[14] The predilection of *B holmesii* for asplenic hosts may be related to the fact that impaired function of the spleen leads to an increased susceptibility to encapsulated organisms. During cycles of sickling, patients with SCD develop vaso-occlusion that can lead to splenic autoinfarction. Impaired splenic filtration and reduced opsonization leads to a reduced ability to destroy encapsulated organisms.[15] Although preliminary investigations have suggested the presence of a capsule in other *Bordetella* species, the presence of a capsule in *B holmesii* remains unknown and controversial.[6] The presence of a capsule may be further evidence explaining the increased risk of developing this infection in asplenic patients, such as our patient.

Furthermore, optimal treatment of *B holmesii* remains challenging. Carbapenems and fluoroquinolones are suggested as having better clinical utility in the treatment of *B holmesii* because of their lower minimum inhibitory concentration value compared with cephalosporins.[14] Because our patient was treated with cephalosporins alone initially, the bacteremia may have been inadequately eradicated, leading to the development of endophthalmitis weeks later. Interestingly, identification of *B holmesii* by culture is cumbersome because it may take close to 40 hours to grow and this species does not grow well on MacConkey agar.[16] Given its slow-growing nature, this may also delay timely treatment, highlighting the need for improved laboratory detection of this unusual organism. Both successful identification of the organism and appropriate antibiotic coverage are necessary to ensure such a visually threatening disease is successfully halted.

Conclusions

This case describes a rare organism, *B holmesii*, causing endogenous endophthalmitis in a patient with SCD. The patient was successfully treated with intravitreal and systemic antibiotics. This case report suggests that further studies of *B holmesii* may lead to a better understanding and treatment in the prevention of severe vision loss, especially in patients with SCD who are predisposed to lifelong invasive bacterial infections.

Ethical Approval

This case report was conducted in accordance with the Declaration of Helsinki. The collection and evaluation of all protected patient health

information was performed in a Health Insurance Portability and Accountability Act (HIPAA)–compliant manner.

Statement of Informed Consent

Informed consent was obtained prior to performing the procedure, including permission for publication of any photographs and images.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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