nal stalk, or retina.2,3 It is a neoplasm of childhood that usually becomes clinically symptomatic during the first decade of life (mean age, 5 years).1 However, there are well-documented cases in which the tumor had become symptomatic in adulthood.4-5 The most frequent clinical signs are leukocoria; notching or subluxation of the lens; cataract; and a mass in the iris, ciliary body, or anterior chamber. Almost all tumors are unilateral. There is no predilection of this tumor for race, sex, and laterality.6 It also has a strong tendency to induce secondary glaucoma due to iris neovascularization.

Broughton and Zimmerman1 established the histopathological criteria for malignancy that includes the presence of poorly differentiated neuroblastic cells, numerous mitoses, pronounced pleomorphism, sarcomatous areas, or invasion of other ocular structures with or without extraocular extension. Mostly these tumors are nonpigmented; however, a few cases of clinically pigmented medulloepithelioma of ciliary body have been reported.10 Metastases are very rare and usually occur in cases with extraocular extension.6

Immunohistochemically, the neuroblastic cells are positive for neuron-specific enolase and synaptophysin while the spindle cells in the stroma stain positively for vimentin, glial fibrillary acidic protein, and S100 protein.7 Ultrasonography and cytologic examination of vitreous aspirate have led to correct preenucleation diagnosis of medulloepithelioma in a few cases.8

Shields et al9 concluded that local surgical resection (iridocyclectomy) of the tumor is usually insufficient and enucleation ultimately will be necessary because of tumor recurrence. Six of the 10 patients in their series were managed by local resection, and 5 eventually required enucleation, 4 because of local tumor recurrence. One of the 10 cases in the same series had intraretinal involvement (J. A. Shields, oral communication, April 2004).9 Carrillo and Streeter2 reported a case of malignant teratoid medulloepithelioma in an adult in which the tumor extended over the inner retinal surface (in the macular region), producing large retinal con-
nosed with myelodysplastic syndrome for which he received chemotherapy and a bone marrow transplant. Over the following year, he developed chronic graft-vs-host disease that required systemic immunosuppression.

One month prior to ophthalmologic consultation, the patient was admitted to the intensive care unit for a new skin rash and hepatitis secondary to graft-vs-host disease. His hospital course was complicated by liver failure and neutropenic fevers. His fevers persisted, and he developed several vesicobullous lesions on his arms (Figure 1) and legs over the following 2 weeks. Fluid from 1 of the arm lesions was aspirated for culture. Additionally, 2 blood cultures were drawn 3 days apart. A complete differential blood cell count performed on the day that the first blood culture was obtained revealed anemia and severe thrombocytopenia (hematocrit = 24.2%, hemoglobin = 8.1 g/dL, platelets = 17 × 10^3/μL). His white blood cell count was within the normal range at 7.1 × 10^3/μL (differential cell count [normal range]: 94% neutrophils [44%-74%], 1% bands [0%], 1% lymphocytes [0%-2%], 3% monocytes [4%-14%], and 1% eosinophils [0%-6%]). The ophthalmology department was consulted to evaluate ocular discomfort on the day the first blood culture was obtained.

Initial examination of both eyes was notable for mild conjunctival chemosis, icteric sclera, and irregular corneal epithelium—the constellation of which was consistent with keratoconjunctivitis sicca secondary to chronic graft-vs-host disease. Fundus examination results were normal with no vitritis at this time. Visual acuity measured at the bedside was moderately decreased to the 20/60 level (with correction) in each eye owing to irregular corneal epithelium and mild nuclear sclerotic cataracts. Aggressive lubrication, topical steroids, and cyclosporine eye drops were initiated.

When the patient was reexamined 1 week later, he had a marked improvement in corneal epithelial regularity but still complained of vague ocular discomfort. The visual acuity had dropped to 20/100 in each eye. Repeat fundus examination revealed new bilateral, multiple, slightly raised, whitish-yellow lesions at the level of the retinal pigment epithelium with overlying vitritis (Figure 2). Lesion sizes were variable, ranging from 100 to 400 μm.

Over the course of the week, the blood cultures (Figure 3) as well as cultures from fluid aspirated from the vesicobullous lesion had become positive for _P. wickerhamii_. The diagnosis of choroiditis secondary to algaemia was made, and intravenous amphotericin B therapy was initiated. Voriconazole and fluconazole therapy were considered; however, the severity of the patient’s liver disease precluded their use.

The patient died 3 days after the second eye examination owing to multiple organ failure. A full body autopsy was performed after receiv-
ing appropriate authorization. During the autopsy, a small sample of cerebrospinal fluid was sent for culture. The left eye was submitted intact for histopathological examination. The right eye underwent a vitreous tap of 0.5 mL, and this was submitted for polymerase chain reaction (PCR) analysis using custom primers designed from the *P wickerhamii* 18S ribosomal sequence in the National Center for Biotechnology Information Entrez database (primer set 1: forward primer 5’-TCA AAA AGT CCC GGC TAA TCT CGT GC-3’, reverse primer 5’-CGC TTT CGT GCC TCA ATG TCA GTG TT-3’, annealing temperature of 58°C, 35 cycles, expected product was 319 base pairs [bp]; primer set 2: forward primer 5’-GCT GGT TTG AGA GAA TGA TCA GCC-3’, reverse primer 5’-TCT ACG CAC GCT TTA CGC CCA ATC-3’, annealing temperature of 58°C, 35 cycles, expected product was 303 bp). The right macula was dissected, DNA was extracted by proteinase K digestion and resin chromatography (Qiagight; Qiagen Inc, Valencia, Calif), and the DNA was submitted for PCR analysis.

Culture analysis of the cerebrospinal fluid revealed *P wickerhamii*. Histopathological examination of the left eye revealed numerous *P wickerhamii* sporangia in the choroid (Figure 4). The PCR analysis of the microdissected right macula revealed *P wickerhamii* DNA (Figure 5), although the vitreous was negative for this as shown by PCR.

Comment. Over the past 25 years, more than 100 cases of protothecosis have been identified in humans, with over one third described as having systemic dissemination.1 Although ocular manifestations of protothecosis have been described in animals, they have never been reported in a human.

Font and Hook2 performed a histopathological examination on the eye of a dog that developed acute blindness after being diagnosed with infection by disseminated *P wickerhamii*. The dog was euthanized, and histopathological examination of the left eye revealed multiple microabscesses and necrotic foci containing a myriad of protothecal organisms under the detached retina. Others3-10 have described dogs that developed panophthalmitis, endophthalmitis, and exudative retinal detachments secondary to intraocular protothecosis.

Pathogenicity and virulence of algae in humans appears to be low. A recent study by Torres et al11 described the outcomes of patients with cancer who developed protothecosis. Of the 13 patients included in this series, only 1 died as a result of this infection. Amphotericin B appears to be the treatment of choice for disseminated protothecosis, but limited data to date preclude evaluation of triazole antifungal agents. We considered bilateral intravitreal amphotericin B injections for the patient in the current study; however, after consideration of the patient’s general condition, a discussion by all of the parties involved concluded that observation of the patient while he was receiving systemic therapy was an appropriate initial treatment approach.

Figure 3. Wet mount of blood smear. Round or oval sporangia of *Prototheca wickerhamii* vary from 3 to 15 µm in diameter. Each sporangium contains 2 to 20 endospores; however, only 4 to 8 endospores are visible in 1 plane.

Figure 4. Histopathological examination of the left choroid. The spores of *Prototheca wickerhamii* are densely basophilic, staining purplish-blue (hematoxylin-eosin). Arrows indicate sporangia.
Risk factors for disseminated protothecosis include human immunodeficiency virus, leukemia, malignancies, hemodialysis, corticosteroid therapy, and catheterization. The patient in the current study was receiving long-term immunosuppressive therapy for graft-vs-host disease. These factors likely led to the development of disseminated protothecosis.

In summary, we present, to our knowledge, the first human case of chlorellosis due to algae confirmed by pathological examination. This intraocular infection developed in the setting of positive cultures from 3 sites (skin, blood, and cerebrospinal fluid). Ocular involvement in the setting of disseminated protothecosis was confirmed by histopathological examination and PCR analysis. Although pathogenic protothecosis is likely rare, our findings suggest that algae should be considered a pathogen in the differential diagnosis of chlorellosis in the immunocompromised individual.

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