Answer to Photo Quiz: *Naegleria fowleri*

(See page 1411 in this issue [doi:10.1128/JCM.00401-14] for photo quiz case presentation.)

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Naegleria fowleri is a free-living amoeba commonly found in warm freshwater environments such as hot springs, lakes, and natural mineral water (4). It causes primary amoebic meningoencephalitis (PAM), an acute fatal disease of the central nervous system (CNS). The disease usually affects immunocompetent children and young adults and is commonly associated with swimming or bathing in contaminated, warm waters. *Naegleria fowleri* gains entry into the body through the nose, which gives the amoeba an opportunity to enter the brain. Patients present with headache, fever, alteration in taste or smell, vomiting, and lethargy. Seizures and photophobia may occur. Death usually occurs within 3 to 7 days after initial signs and symptoms. Laboratory studies reveal increased leukocyte count, hyperglycemia, and glycosuria. Cerebrospinal fluid (CSF) examination reveals a pleocytosis with a predominance of neutrophils with increased protein level, frequently greater than 500 mg/dl, and normal or decreased glucose level. Routine cultures and Gram stain are negative for bacteria. The definitive diagnosis is based on the visual detection of the amoebic trophozoite in the CSF or brain tissue. Trophozoites can be identified on Wright Giemsa-stained cytocentrifuged smears of the CSF (5). However, trophozoites may be easily mistaken for macrophages or epithelial cells. The amoeba can also be cultured on nonnutrient agar plated with *Escherichia coli* or by specific monoclonal immunofluorescent staining. Recently, a rapid, multiplex, real-time PCR test which can detect and distinguish three species of pathogenic free-living amoebae (*Acanthamoeba* species, *Balamuthia mandrillaris*, and *Naegleria fowleri*) was developed (6).

Naegleria fowleri has three stages: trophozoite, flagellate, and cyst. The trophozoite form is found in the CNS and measures about 8 to 12 μ m in diameter. The cytoplasm is finely granular with multiple mitochondria, lysosomes, and vacuoles and rounded pseudopods. The nucleus is centrally placed with finely granular chromatin containing a dense, spherical nucleolus.

Physicians treating individuals who present with acute pyogenic meningitis should consider the diagnosis of PAM, particularly if the patient has a recent history of swimming in warm fresh water.

Although the disease is invariably fatal, this patient represents the third survivor in North America. Recently an investigational drug, miltefosine, was tried in combination with other drugs such

as amphotericin B, rifampin, fluconazole, and dexamethasone. Miltefosine has shown amoeba-killing activity against free-living amoebae, including *Naegleria fowleri*, in the laboratory. The CDC now has a supply of miltefosine for treatment of *Naegleria fowleri* infection.

The patient sustained a complicated but relatively stable 1-month hospital course, with a final diagnosis of static encephalopathy secondary to amoebic meningitis complicated by respiratory insufficiency. He was discharged to an inpatient rehabilitation facility in stable condition. At the time of discharge, he was alert and oriented but had been tracheotomy and gastric tube dependent and also sustained significant contractures and hyper-tonia over both extremities bilaterally. No additional information is available.

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