CASE REPORT

Leptospirosis in a Caver Returned from Sarawak, Malaysia

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This article describes a case of leptospirosis in a man who returned from caving in Sarawak, Malaysia, and includes a discussion of epidemiology, pathophysiology, diagnosis, prevention, and treatment. The patient presented with symptoms of leptospirosis, which was confirmed by microhemagglutination titers. He became infected despite taking doxycycline daily for malaria prophylaxis. Leptospirosis is an important consideration in any returned traveler with fever. The spirochete spreads from animals to humans via water. Caving in tropical endemic zones may increase exposure risk due to the combination of multiple skin abrasions with immersions. Water in caves may increase infection risk because of increased water pH. Standard prophylaxis may be inadequate in cases of high-risk exposures.

Key words: leptospirosis, expeditions, fever, returned traveler, caving, prophylaxis, doxycycline

Introduction

Leptospirosis is a potential cause of fever in the returned traveler. Transmission has been associated with animal and water exposure.¹ Recreational exposures have included white water rafting,² kayaking,^{3,4} canoeing, hunting, and riding trail bikes through puddles.¹ Recreational^{5,6} and competitive^{7–9} swimming in outdoor water has also resulted in leptospirosis. Caving, which can include water and animal urine exposure, may be a special risk.¹⁰ Leptospirosis has been reported among British cavers in Sarawak¹¹ and, more recently, among participants in an adventure race in Sabah, Malaysia, that included “spelunking.”^{3,12,13} This case report describes a confirmed case of leptospirosis in an American caver returned from Sarawak, Malaysia.

Leptospirosis is caused by spirochetes of the genus *Leptospira*. Each species may have multiple serovars, which are somewhat host specific.¹⁰ Animal reservoirs include rodents, livestock, cats, dogs, and rarely bats.^{10,14} The organism is excreted in urine into water and then enters the human host through contact with mucous membranes, the conjunctiva, or abraded skin.^{1,15} Risk may be higher in times of high precipitation or

flooding.^{10,16} Human to human transmission is not a concern.¹⁰ The infection may occur in temperate zones but is more common in tropical areas.¹ It is endemic in Malaysian Borneo.³

The Gunung Buda Project explored the caves of the Gunung Buda massif, just north of Mulu National Park, from 1994 to 2000. Participants were experienced cavers, most with international caving experience. Because of concerns over leptospirosis in previous expeditions to the area,¹⁷ each person was encouraged to take 200 mg of doxycycline weekly for leptospirosis prophylaxis,¹⁸ unless already using 100 mg/d for malaria prophylaxis.

Case Report

The patient was a 37-year-old white man who did reconnaissance work for 4 weeks at Gunung Buda, north of Gunung Mulu National Park, in Sarawak, Malaysia, in January 1994. His exploration included wading and swimming through several caves, immersing himself to the point of submerging half his face where the ceiling was low. The stream in which he was immersed drains an 11-km cave system upstream. He took 100 mg/d of doxycycline and reported generally good adherence. He drank both surface water and collected rainwater. He filtered and iodized both throughout the expedition.

On returning to the United States, approximately 10 days after his last cave trip, he developed chills, tem-

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peratures to 40°C, headaches, and myalgias. He was admitted to his local hospital for hydration and workup. Physical examination results were negative except for a temperature of 38.8°C and mild conjunctival inflammation. The results of spinal tap, blood cultures, stool cultures, a chest radiograph, 2 malaria smears, an acute hepatitis panel, Q-fever antibodies, and an acute *Leptospira* indirect hemagglutination titer were all negative. Aspartate aminotransferase and alanine aminotransferase levels were elevated at 100 and 115 U/L, respectively. Prothrombin time, bilirubin level, and creatinine level were normal. No urinalysis was performed. His fever and symptoms resolved throughout 24 hours with ceftriaxone, 1 g intravenously every 12 hours, and tetracycline, 500 mg orally every 6 hours. The results of a convalescent *Leptospira* microhemagglutination titer 2 months later were positive at 800:1.

Discussion

The clinician should suspect leptospirosis in any returned febrile traveler, especially one returned from the tropics or exposed to outdoor water. Common but non-specific acute symptoms include fever, chills, myalgias, and headache.^{1,10} More specific physical findings include conjunctival suffusion, proteinuria, and hematuria. Urinalysis may offer an early clue to diagnosis. Incubation is usually 5 to 14 days but may be as long as 30 days.^{3,10} The clinical spectrum of leptospirosis ranges from asymptomatic to severe. Most patients develop limited anicteric disease.

After the acute phase a patient may develop symptoms again in an immune mediated phase. Symptoms may include aseptic meningitis, adenopathy, hemorrhagic pneumonitis, and ocular manifestations such as conjunctivitis or uveitis. The most feared late complication is Weil syndrome, which includes renal failure and jaundice and occurs in 5% to 10% of cases.¹

Rats are a common reservoir of leptospirosis.¹⁴ They are numerous around Gunung Buda, including the underground portions of the caves visited by the patient. Bats have also been found to carry leptospirosis in southeast Asia.¹⁴ They also are plentiful in the caves visited by the patient, as well as those caves hydrologically connected.

Several aspects of cave exploration in a tropical climate maximize leptospirosis exposure. High heat and humidity lead to minimal protective clothing, typically shorts and a T-shirt. Frequent contact with rock results in multiple abrasions, a known portal of entry for the organism.^{1,15} Underground rivers may concentrate exposure risk by draining multiple caves. Caves serve as multilevel habitats for bats and rats, but they then drain

through single streams. Caves such as those at Gunung Buda form predominately in limestone. Water that percolates through this carbonate rock may attain a less acidic pH, which favors spirochete survival.¹⁹ Better survival leads to larger concentrations and therefore a larger potential inoculum.

All expedition members had multiple abrasions, and all had at least partial immersions while traveling in or to the different caves. In addition, this patient had significant underground immersions in water draining from large caves, which may have increased his risk.^{2,5} An alternative infection route is through ingestion of contaminated water. Any surface water may be contaminated. The camp's supply was rainwater collected from a plastic tarp roof during near-daily deluges. Although this "distilled" water ought to be safe, rainwater catchment for drinking has been identified as a leptospirosis risk, presumably from rats urinating on the catchment surface.²⁰ Most cavers at Gunung Buda, including this patient, used supplemental disinfection such as iodine, chlorine, or filtration, which would make it safe to drink even if it started out contaminated. All participants bathed in the nearby Medalam River, whose source is the forest instead of the caves.

The gold standard of diagnosis is isolation of spirochetes in culture, but its sensitivity is low.¹⁰ The preferred indirect detection technique is microhemagglutination titers. A positive result is confirmed by a 4-fold increase over time or a rise above 200:1 after a negative titer result.²¹ An alternative is detection of immunoglobulin M antibodies. These results may be positive faster but are ideally confirmed by microhemagglutination titers.²² The sensitivity of antibody tests based on single serovars may vary geographically. Mild cases may be treated with oral doxycycline or ampicillin. More severe cases require intravenous penicillin.¹ A Jarisch-Herxheimer reaction is a potential complication of penicillin treatment.

The patient developed leptospirosis despite taking 100 mg/d of doxycycline. This dose is recommended for malaria prophylaxis. It is not known if malaria dosing would prevent leptospirosis. The patient chose to take doxycycline because he was intolerant of mefloquine. When studied for leptospirosis prevention, doxycycline has been dosed as 200 mg/wk.^{18,23,24} Prevention would depend on whether control is achieved by a higher maximum concentration (as provided by 200 mg once weekly) or by total dose throughout the week.

Weekly dosing has had mixed results. Takafuji et al¹⁸ studied 200 mg once a week in 940 soldiers from nonendemic zones while in Panama. This placebo-controlled prophylaxis trial demonstrated a reduction of the attack rate from 4.2% to 0.2%. The lone case in the treatment group received his last dose of doxycycline 6 days late

and approximately 1 week after the time of probable exposure.¹⁸ In a heavily preexposed population in an endemic zone, Sehgal et al²⁴ showed no change in serologic infection rate but showed a change in the attack rate of clinical disease. The authors speculated that weekly prophylaxis in the presence of frequent high infecting doses of bacteria was insufficient to prevent subclinical infection, while still demonstrating a reduction in systemic disease. They further speculated that increasing the prophylaxis frequency could increase the protective effect. A pilot study in Brazil suggested that prophylaxis after a single high-risk water exposure prevented symptomatic disease but again not infection.²³

Our patient took daily doxycycline with few missed doses but did not take the higher recommended weekly dosing. This case, as well as previously reported ones, suggests that leptospirosis is a significant risk for cavers in endemic areas. Skin abrasions inherent in tropical caving increase potential portals of entry, and immersion maximizes exposure. Cave water may have greatly increased concentrations of leptospires. Preventive measures such as water disinfection and appropriate protective clothing are important but may not be enough. Usual prophylaxis in these situations may be insufficient. Although unproven, cavers and others should consider supplemental doxycycline of 200 mg at a time of any high-risk exposures, such as immersions,² swallowing river water,²⁵ or contacts with bat or rat urine, to augment daily or weekly prophylaxis. Malaria dosing of doxycycline is probably inadequate to prevent leptospirosis in these cases of significant exposures.

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