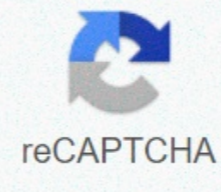




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How does amoeba eat

Your chances of infection are small, but there are precautions you take. Health officials in North Carolina report that Lauren Seitz, an 18-year-old Ohio woman who died on Sunday after a rafting trip with her church earlier this month, had contracted primary amebic meningoencephalitis (PAM). PAM is an almost always fatal infection caused by *Naegleria fowleri*, aka the brain-eating amoeba. There's no denying it's terrifying. But here's what experts who have encountered the parasite want you to know: [PAM] is very deadly, but very rare, even in areas where it's endemic, says Stanley Deresinski, MD, a clinical professor of medicine in the division of infectious diseases at Stanford University. Early symptoms, which begin between one and nine days after exposure, are similar to those associated with meningitis, and include severe headache, fever, nausea and vomiting. According to the Centers for Disease Control and Prevention, a total of 138 infections were reported in the United States between 1962 and 2015. Hundreds of millions of visits to swimming spots arrive each year in the U.S. that result in 0-8 infections each year, the agency says. To put that in perspective, more than 3,500 people drown every year. *Naegleria fowleri* can be found in soil and warm freshwater environments such as lakes, rivers and hot springs. It thrives in summer, when air temperatures climb into the 80s and 90s and water temperatures reach the 70s. RELATED: 4 Gross Diseases You catch when you swim The majority of pam infections have occurred in the southern states of Florida and Texas alone accounting for more than half of all U.S. cases. But as climate change warms the world, *Naegleria fowleri* seems to have expanded its territory. Minnesota confirmed cases in both 2010 and 2012. If temperatures continue to rise, we can see this in areas farther north, said Bobbi Pritt, MD, director of the Clinical Parasitology Laboratory at Mayo Clinic's Department of Laboratory Medicine and Pathology. Although the parasite likes heat, it doesn't necessarily like humans. *Naegleria fowleri* are free-living organisms that would much rather stay in the environment than end up in humans. We're a dead-end host, not part of their life cycle, says Dr. Pritt. We don't get infected by ingesting contaminated water, but by allowing the water into our nostrils, explains Dr. Deresinski. The parasite enters the central nervous system through the odor nerve in the nose. In terms of the big risk, it's dipping your head in warm, non-chlorinated fresh water, he explains. When I lived in Florida, I was floating around in a lake all the time, but I never put my head under water. thing to avoid is situations that will clearly lead to water in your nostrils. RELATED: This is why it's so important to shower before swimming in a pool when you're To spend time in fresh water, blocking your nasal cavities with pinched fingers (if you take a short dip) or wearing a nasal plug (if you are going tubing, rafting, or swimming) will deny the parasite entrance, full stop. If I had a really good nose plug, I wouldn't even think about [potential infection], says Dr Pritt. It is also important to prevent infection through devices such as neti pots, which have been linked to PAM in a few recent cases. The safest approach is to boil water before you use it [to irrigate your nasal cavities], and to clean your neti pot with water that has been boiled, she says. The chances of you getting this terrible infection are incredibly small. By making a habit of a few common sense precautions, you make them infinitely small. Composed of a single cell, amoeba seem harmless enough: They look like playful critters waltzing under the floodlights of a microscope until they come upon a group of bacteria. Then, this rather innocent amoeba suddenly morph into sinister blobs, engulfing the bacteria and slowly tearing them apart with a bevy of digestive enzymes. It's hard to cry about killed bacteria, but the digestive power of amoeba is the stuff of nightmares when it's set in a human brain. Infections with *Naegleria fowleri*, the so-called brain-eating amoeba, are extremely rare, but also extremely deadly. Only 146 cases have been reported in the U.S. since 1962, with only four surviving the infection; So there's a 97% chance of death. Unfortunately, on July 22, a 59-year-old North Carolina man became the first person to die from the infection this year after swimming in a lake in a water park. I study parasites and have a particular interest in those who focus on the brain, which is why this amoeba caught my interest. How N. fowleri gets into the brain, fowleri lives in warm bodies of fresh water where it dines on bacteria in the sediment. As such, most infections with this amoeba in the U.S. have occurred in southern states, especially Texas and Florida, during the summer. When the sediment of a lake is disturbed, amoeba is stirred into the water. Swimmers can then inhale the parasite through their nose. From there, N. fowleri penetrates the odor nerves and migrates to the brain, where it causes a dangerous condition called primary amebic meningoencephalitis. While swimming in fresh water is the most likely source of this amoeba, this same organism and other types of amoeba can cause brain infections in people who use tap water instead of sterile water or salt when using the nasal rinse Neti pot. The brain is moist and warm, as are the lakes and hot springs where the amoeba But the brain has no bacteria for the amoeba to eat, so the organism attacks brain cells for nutrients. However, the immune system is not idly at it, while the parasite eats its way through the brain. The It a huge swarm of immune cells to the infected zone, which causes inflammation and swelling of the brain. Unfortunately for the person whose brain is infected, this battle is waged in a solid skull, which cannot expand to accommodate a swelling brain. The increase in skull pressure disrupts the brain's connection to the spinal cord, jeopardizing communication with other parts of the body, such as the respiratory system. A creeping and fast killer Symptoms can appear for two days, or as late as two weeks, after inhalation of N. fowleri. The first symptoms are headache, fever, nausea and vomiting, and a change in sense of smell or taste (due to damaged odor nerves mentioned above). The infection progresses rapidly through the central nervous system, producing stiff neck, confusion, fatigue, loss of balance, seizures and hallucinations. Patients usually succumb to the infection within five to seven days of the onset of symptoms. There are several reasons why N. fowleri is so deadly. First, the presence of the parasite leads to rapid and irrevocable destruction of critical brain tissue. Secondly, the first symptoms can easily be confused with a less serious disease, which takes costly treatment time. Third, there is no quick diagnostic test for N. fowleri, and patients are often mistreated for viral or bacterial meningitis. Finally, there are no established drugs with proven efficacy against the amoeba, although miltefosine shows promise. Compounding the problem is the fact that most drugs have difficulty penetrating the brain and, as primary amoeba meningoencephalitis is a rare disease, very little research is conducted. It is important to keep in mind that millions of people are exposed to N. fowleri and never get sick. Those who study this amoeba do not know why a small subset of exposed individuals develops primary amoeba meningoencephalitis; they may have a genetic difference that makes them more vulnerable to infection, or forcefully inhaled an overwhelming amount of the parasite. So if you're going swimming in warm freshwater lakes or streams, especially if you want to dive or dive underwater, consider wearing a nose clip to keep amoeba parasites out of your brain. Experts also advise that people avoid stirring the sediment at the bottom of these bodies of water where the amoeba live. [Like what you've read? Want more? Sign up for The Conversation's daily newsletter.] Bill Sullivan, Professor of Pharmacology & Toxicology, Author of Pleased to Meet Me: Genes, Germs, and the Curious Forces that Make Us Who We Are, Indiana UniversityThis is republished in The Conversation under a Creative Commons license. Read the original article. The single-celled threat rarely infects people. That's what makes it so hard to treat. Haley WeissJuly 29, 2019Ognen Teofilovski / ReutersLast week, week, North Carolina man became a notorious microbial killer first confirmed victim this year. Eddie Gray, 59, had unknowingly encountered a brain-eating amoeba while swimming in an artificial lake near Fayetteville in mid-July; 10 days later, he was dead. Since the brain-eating amoeba was first recognized and named, in 1970, gruesome reports of the disastrous attacks have made headlines almost every year. About 97 percent of confirmed cases in the United States are fatal. But the infection is also incredibly rare, and the small sample size leaves the epidemiologists who study it and the doctors who encounter it with their hands tied. It is perhaps one of nature's most perfect crimes. Despite their gruesome nickname, most brain-eating amoebas never eat a single brain. The single-celled swimmer, formally known as *Naegleria fowleri*, passes his time resting in a dormant state or, when warm enough, splashes around and chews on bacteria. Unlike most waterborne pathogens, it is completely benign if you drink it. It only becomes dangerous when, thanks to a person enjoying a day in a water park or a quick rinse in a stream, the amoeba is pulled from its bacterial buffet and swept into the dark corners of the human nose. If the amoeba is not yet in eating mode at this point, the intense eruption of human body heat can help shape-shift out of rest. Like someone else waking up somewhere unknown, the brain-eating amoeba is desperate for a food source, so it slips its way up the olfactory nerve until it spies a tasty-looking tangle of neurons and digs in. The host's immune system, which observes an unwanted visitor, sends an attack of white blood cells to bring down the partying parasite. That commotion leads to a swollen and ultimately irreparably damaged brain. We have these hard skulls to protect our brains from traumatic injuries, said Jennifer Cope, a medical epidemiologist who studies N. fowleri for the Centers for Disease Control and Prevention. But when you start to swell, that hard skull gets in the way. With nowhere else to go, the brain stem and other nearby regions are pushed down through the bottom of the skull. For most victims of the brain-eating amoeba, this displacement is the direct cause of death. All in all, this deadly infection is known as primary amebic meningoencephalitis (PAM). It is similar to viral and bacterial meningitis, except the intruder that causes it to come out of the water and eat your brain. With only about 30 cases in the United States in the past decade, PAM is an unusual of an already rare disease. Since N. fowleri was first identified by Australian doctors about 50 years ago, there have been at least 146 confirmed cases of PAM in the United States, with only four survivors.N. fowleri is so alarmingly dangerous because, such as bacterial and viral meningitis, meningitis, is almost impossible to recognize until long after any of the interventions that have worked for some victims are even an option. Even when a patient makes it to a hospital within a few days of infection, PAM is often mistaken for one of these types of meningitis (distinguishing them requires an invasive spinal tap) and treated as such, to no avail. Experts agree that for each confirmed case, there are probably one or two who were misdiagnosed and instead recorded as more common meningitis deaths. Gray's death fits into the most common story of an N. fowleri fatality. Although not much is known about the organism, Cope says: We do know that it is thermophilic – it likes heat. Swimmers in balmy southern lakes and rivers are generally unlucky few every summer, but in recent years there have been some related outliers. In 2013, a 4-year-old boy died unexpectedly in the New Orleans neighborhood of what doctors later decided to be PAM. The CDC got a call. I asked the same questions we usually do about swimming in lakes, and [the parents] said they hadn't been to lakes, Cope says. It led us to find that really was the only thing he had played on the backyard slip 'n slide-with a hose connected to the backyard faucet. Two years earlier, a 20-year-old man in the same parish had developed PAM after rinsing his sinuses with a neti jar he had filled in the sink. We went back and we did sampling again, Cope said. This time we found it in the house where the patient had been exposed, but we also found it in the drinking water distribution system, in the pipes leading from the street into the house. It was the first time the amoeba had been spotted in a centrally handled American system. What the problem was in Louisiana was that they used chloramines, says Charles Gerba, a microbiologist at the University of Arizona who studies groundwater N. fowleri. In Arizona, Gerba says, chlorine is the standard choice for disinfecting municipal water, but about 30 percent of the country instead uses chloramine, a blend of chlorine and ammonia that leaves behind less harmful byproducts such as chloroform. Chlorine and chloramine otherwise disappear into water, which means that under the right conditions - for example, low water turnover in areas left partially empty by Hurricane Katrina - the less aggressive chloamine can leave some bags untreated. Louisiana's polluted system was flushed in 2013, and the Environmental Protection Agency began regularly monitoring water in the region. But the process is complicated, and spotting the amoebas can take weeks once they show up. There is no fast for the parasite, partly because so much remains known about it. Cope's lab is currently in the early stages of sequencing the genomes of N. fowleri samples collected by the CDC the United States over the years. It has identified three genotypes so far, she says, but the system doesn't have much granularity to it and isn't used much yet. The goal is to eventually develop a kind of amoeba dictionary detailed enough to match samples of patients with specific collections of the creatures, giving scientists the ability to pinpoint exactly where someone encountered the pathogen. Today, the clearest risk factor is still hot water temperatures, making it easier for the microbes to reproduce. As far as humans are concerned, Gerba says, with global warming, the water is warming, and people expect to see more cases. Brain-eating amoebas around the world have generally been downgraded to sunny climates, but when two PAM cases were confirmed in Minnesota in 2010 and 2012, it raised the specter of a climate change-induced N. fowleri explosion. In a 2017 review, Cope and her colleagues at the CDC warned that the Minnesota cases could be an example of things to come. Today, she emphasizes that despite all the geographic changes, the number of annual cases in the United States remains stable, and too small to test for statistically significant trends. Given how rare an N. fowleri infection is, worrying about it is like worrying about falling into a volcano: The chance of it happening to you is small, and making it even smaller is simple. All it takes are steps like purifying tap water an extra time before you flush your nostrils with a neti pot and don't dip your head (or use a nose clip) when you swim in nature - even if the water looks really, really clean. I worry about the word of course all the time. Every time you swim in natural waters, you're at increased risk of getting sick, gerba says. People think, Oh, it's so natural; It's so fresh, and I say, yes, all the birds pooped in it this morning.