

Did a lake trigger a deadly disease?

Researchers hope to explain why Lou Gehrig's disease seems to occur more often in people who live near lakes and ponds where cyanobacteria bloom

By Terry J. Allen, Globe Correspondent | September 14, 2009

Researchers investigating a deadly disease cluster near a New Hampshire lake are tracking clues that stretch from a delicacy eaten on Guam to a 3.5 billion-year-old type of bacteria and the green scum that coats many New England waters.

The scum - blooms of cyanobacteria often misnamed blue-green algae - produces a toxin that doctors at Dartmouth-Hitchcock Medical Center in Lebanon, N.H., suspect might have triggered cases of amyotrophic lateral sclerosis along the north shore of nearby Mascoma Lake.

Using patient records and mapping software, the Dartmouth-Hitchcock team looked for ALS clusters in Maine, New Hampshire, and Vermont. Their preliminary data suggest that the disease, also known as Lou Gehrig's disease, is about 2.5 times more prevalent among people who live within a half-mile of water bodies with past or current cyanobacteria colonies.

The incidence of ALS was highest near Mascoma Lake, where nine patients have been diagnosed since 1990, all but one since 2000 - a rate at least 10 times the US average of two in 100,000 people diagnosed annually.

The neurodegenerative disease eventually immobilizes patients and, inevitably, destroys their ability to swallow and breathe. In one survey, doctors said ALS is the diagnosis they most dread giving.

"The disease can progress so fast, and their struggle is so hard," said Dr. Tracie Caller, the Dartmouth-Hitchcock resident who designed the mapping project. Eight of the Mascoma Lake patients are already dead.

In most cases, the cause of ALS is unknown. But scientists suspect genetics loads the gun, and environment pulls the trigger.

Paul Alan Cox, executive director of the Institute for Ethnomedicine in Jackson Hole, Wyo., and a small group of researchers around the world are investigating whether BMAA (β -methylamino-L-alanine), a toxin produced by cyanobacteria, is one such trigger - for ALS and other neurodegenerative diseases. Several studies have reported that some ALS victims' brains contained BMAA, and Cox and other researchers have found it in the brains of a small number of deceased North American Alzheimer's patients.

But the research is still at an early stage. Cox cautioned people not to overreact. After news reports of the Dartmouth-Hitchcock research earlier this year, some area residents voiced concern about going in Mascoma Lake.

“If our hypothesis is correct, only very few people are susceptible to the toxin,” said Cox, the pioneer of research into a possible link between ALS and cyanobacteria. “And, until there is an animal model showing that low, chronic doses of BMAA over a long period of time can produce progressive irreversible neurodegeneration, the hypothesis remains unproven.”

Brain tissue from the deceased Mascoma Lake patients and water samples from Mascoma and other bodies of water with large blooms were sent to Cox’s lab by the New Hampshire researchers. Until publication of a pending journal article, the researchers won’t say whether they found BMAA.

“My guess is we will eventually find it in Mascoma,” said Dr. Elijah Stommel, lead investigator of the Dartmouth-Hitchcock study. “Now, when I diagnose ALS in a patient who has lived near a lake, it always sends a chill up my spine.”

Maureen Hutchinson of Tilton, N.H., is one of Stommel’s ALS patients, though she’s not part of any apparent cluster. But the 55-year-old former house cleaner wonders about the “light layer of green” on Sandogardy Pond in Northfield, N.H., where she grew up.

“One day, two years ago, my muscles started to twitch,” Hutchinson said recently as she sat in a fast-food restaurant with her sister Diane Glover. They alternated between laughing about the past and gathering courage for the future. “I was told I had three to five years,” Hutchinson said. “I cried a lot, and thought I don’t deserve it. But I suppose everyone feels that way.”

Cyanobacteria are found in many lakes, and James Haney, a biology professor at the University of New Hampshire’s Center for Freshwater Biology, said BMAA is “produced by most cyanobacteria found in New England.” But it is a tiny molecule, “and finding it is needle-in-a-haystack hard,” requiring complicated techniques and expensive equipment, said Haney, who took samples from more than 80 New Hampshire water bodies this summer. Harder yet will be proving it is the culprit.

One solid clue is that cyanobacteria are known to damage the liver, kidneys, and nervous system. Last summer, a St. Lawrence River bloom killed fish, birds, and mammals; dogs can get sick or die after lapping scum-coated New England waters.

Discovering the source of acute poisonings is easy, however, compared with isolating the cause of diseases such as ALS that develop over decades.

That is why the researchers are looking back to a cluster of neurodegenerative diseases, including ALS, on a Pacific island.

After World War II, large numbers of Guam's indigenous Chamorro population began suffering from ALS and Parkinsonism-dementia complex. Cox and his colleagues found high BMAA concentrations in the brain tissues of Chamorros who died of the combined ailments, but not of other causes. They suspected the source was cycad seeds ground for flour. They found that the toxin is produced by cyanobacteria in the roots of the cycad plant, but the BMAA content of the seeds seemed too low to be toxic to humans.

Another puzzle piece clicked with the realization that large bats, called flying foxes, ate the seeds, and Chamorros, in turn, ate the bats - in their entirety - in a coconut cream stew. The tasty mammals were "biomagnifying" BMAA, so that one bat contained as much BMAA as 1,000 kilograms of cycad flour.

The timing of Guam's ALS epidemic provides further evidence of a link to bats and BMAA. Chamorros used to eat flying foxes only occasionally, because they were difficult to catch. But after the US military established huge bases on the island, the populace gained the disposable income and firearms that allowed them to feast often on the bats. The rise in ALS followed the increased consumption, and when overhunting caused the bat population to crash, there was a decline in ALS cases.

"I was stunned," Cox said of his team's discovery of high BMAA levels in bat tissue. "Since cyanobacteria are so ubiquitous, we realized that what began as a study of a few villages in a remote island might have worldwide implications for human disease."

Still, large holes in the puzzle remain: Are people near cyanobacterial blooms exposed to BMAA through inhalation, drinking water, or bioaccumulation through the food chain, as on Guam? Since cyanobacteria blooms are so common, why haven't more ALS clusters been noticed around bodies of water? Why haven't animal experiments shown links between BMAA and the disease?

Some scientists believe the cyanobacteria trail is a dead end, and Cox and the New Hampshire scientists readily acknowledge the possibility. "Scientists often end up stumped," said Stommel. "I don't mind the frustration, and find those puzzles exciting."

As for the people who already have ALS, doctors can do little but watch the inevitable decline and provide comfort.

"I used to say, why can't I stay home like rich people," said Maureen Hutchinson. Glancing at her crutches, she added, "Now I do stay home."