Researchers find algal ancestor is key to how deadly pathogens proliferate

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Long ago, when life on our planet was in its infancy, a group of small single-celled algae floating in the vast prehistoric ocean swam freely by beating whip-like tails, called flagella. It's a relatively unremarkable tale, except that now, over 800 million years later, these organisms have evolved into parasites that threaten human health, and their algal past in the ocean may be the key to stopping them.

The organisms are called Apicomplexa, but are better known as the parasites that cause malaria and toxoplasmosis—serious diseases that infect millions of people every year, particularly in the developing world.

Now, researchers at the University of Georgia have discovered how an important structure inside these parasitic cells, which evolved from the algal ancestor millions of years ago, allows the cells to replicate and spread inside their hosts. Their research, published December 11 in the open access journal PLOS Biology, may lead to new therapies to halt these deadly pathogens before they cause disease.

In order to survive, the parasitic Apicomplexa must invade an animal or human and force its way into the cells of its host. Once inside the host cell, the parasite begins to replicate into numerous daughter cells that in turn create additional copies, spreading the infection throughout the body.

In their study, the researchers demonstrate that during the process of replication the parasite cell loads genetic material into its daughter cells, via a strand of fiber that connects the two. By altering the genes for the components of the fiber in the laboratory, the researchers discovered that they could prevent parasite replication, rendering the parasite essentially harmless.

"These altered parasites can initially infect cells, but once we turn off the fiber genes, they cannot create new daughter cells and spread," said Maria Francia, lead author of the study. "Since it cannot replicate, the parasite eventually dies without causing serious harm."

This replication fiber appears to have evolved from the flagellum that enabled ancient algae to swim.

"This was a surprising finding," said Boris Striepen, Professor at the University of Georgia's Department of Cellular Biology and senior author of the study. "These parasites no longer use flagella to swim, but they have apparently now repurposed this machinery to organize the assembly of an invasive cell."

Current treatments for diseases like malaria are threatened by the parasite becoming resistant to the drugs, so the need for new therapies is always pressing. However, this algae-based connective fiber may serve as a promising target for anti-parasitic drug development, said Striepen. He cautions, however, that more work must be done to learn how to manipulate or destroy the fiber in parasites that have infected humans or animals.

Both Striepen and Francia argue that scientists do well to pay close attention to the evolutionary history of the organisms they study.

"It is extremely important to understand the evolution of different organisms, but especially the evolution of pathogens," Striepen said. "The analysis of their evolution produces important opportunities to develop treatments, but it also helps us understand the basic structures of the pathogens that we must fight."

More information: Francia ME, Jordan CN, Patel JD, Sheiner L, Demerly JL, et al. (2012) Cell Division in Apicomplexan Parasites Is Organized by a Homolog of the Striated Rootlet Fiber of Algal Flagella. PLOS Biol 10(12): e1001444. doi:10.1371/journal.pbio.1001444

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