Researchers discover new mechanism for Type IV pili retraction in Vibrio cholerae

January 4 2017

The Wilson's warbler is an "avoider" bird. Credit: John Marzluff/University of Washington

Type IV pili, essential for many pathogens to cause disease, are hair-like appendages that grow out of and are retracted back into bacteria cells,

enabling them to move and adhere to surfaces. Although pathogenic bacteria often rely on a specialized molecular motor to retract their pili, a new study in *PLOS Pathogens* reveals that a minor pilin protein elicits pilus retraction in the cholera bacterium, *Vibrio cholerae*.

Bacteria utilize a number of highly sophisticated molecular tools to colonize their hosts. One of the most ubiquitous is a complex nanomachine called the Type IV pilus. This nanomachine has as few as 10 to as many as 30 molecular components, producing exquisitely thin filaments that extend from the bacterial surface and that can be several times the length of the bacteria itself. These pilus filaments have a remarkable array of functions that rely on their ability to (i) adhere to many substrates, including host cell surfaces, pili from nearby bacteria, DNA and bacterial viruses (bacteriophage), and (ii) to depolymerize or retract, which pulls the bacteria along mucosal surfaces, pulls them close together in protective aggregates, and can even draw in substrates like DNA and bacteriophage for nutrition and genetic variation.

In collaboration with researchers from Dartmouth College and Simon Fraser University, Dr. Nicolas Biais, Assistant Professor of Biology at Brooklyn College, City University of New York (CUNY), developed an assay in his laboratory that revealed for the first time the V. cholerae Type IV pilus can retract without this molecular motor, and that retraction is necessary for these pili to function. Instead of a molecular motor, a small minor pilin protein triggers pilus retraction. "The magnitude of the forces though is much smaller," said Dr. Biais. "If *Neisseria gonorrhoeae* can pull roughly 100,000 times its bodyweight, *Vibrio cholerae* barely makes it to 1,000 times of its bodyweight. This is a new mechanism for retraction that will help understand how other pili and closely related secretion systems can work and potentially help with the design of novel antibiotics."

"This report [...] demonstrates that the bacterium that causes cholera

powers a nanomachine required for infection differently than other disease causing bacteria," said Dr. Hank Seifert, Professor of Biomedical Sciences at Feinberg School of Medicine, Northwestern University, who was not involved with the study. "These findings drastically alter our understanding of how these nanomachines function to provide insights into the mechanisms allowing cholera and the development of synthetic nanomachines."

Research on how Type IV pili function not only advances our understanding of *V. cholerae* pathogenesis, but will also aid in developing future prevention and treatment strategies for cholera.

More information: Dixon Ng et al, The Vibrio cholerae Minor Pilin TcpB Initiates Assembly and Retraction of the Toxin-Coregulated Pilus, *PLOS Pathogens* (2016). DOI: 10.1371/journal.ppat.1006109

Provided by The City University of New York