Could slowing down the swimming speed of the Lyme disease spirochete help treatment?

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The Lyme disease bacterium swims in an undulating pattern throughout the body. “The flagella reside within the periplasm, the space between the bacterial cell wall and the outer membrane,” according to Harman, from the Department of Molecular and Cellular Biology, University of Arizona. [1] “Rotation of the flagella within the periplasm causes the waveform to propagate, leading to a traveling wave undulation of the entire body.”

The researchers' earlier work with mathematical modeling predicted that the shape of a Lyme disease spirochete might affect pathogenesis. “It is likely that the specific shape of B. burgdorferi is important in its ability to infect mammals,” says Harman. “Consequently, altering the shape and/or stiffness of the bacterium could affect pathogenesis.”

Several antibiotics were identified that are known to affect cell wall synthesis. “Although doxycycline acts through inhibition of protein synthesis, amoxicillin and cefuroxime axetil both interfere with cell wall synthesis.” According to Harman, “Disruption of either the cell wall itself or of the proteins that are involved in synthesizing it eventually leads to cell lysis.”

Vancomycin reportedly reduced the swimming speed of the Lyme disease spirochete by about 15% by reducing the cell wall stiffness.

The researchers chose vancomycin to examine the effects of antibiotics on cell wall synthesis. Vancomycin “has previously been shown to be active against B. burgdorferi in vitro” in two studies identified by the authors. [2, 3] The researchers were also able to alter both the shape and speed of the Lyme disease spirochete in vitro.

Vancomycin reduced the swimming speed of the Lyme disease spirochete by about 15% by reducing the cell wall stiffness. Their results allowed the authors to conclude “since motility is crucial to the virulence of B. burgdorferi, the results suggest that sublethal doses of antibiotics could negatively impact spirochete survival by impeding their swim speed, thereby enabling their capture and elimination by phagocytes.” [1]

Their conclusions are based on in vitro laboratory data. It is not clear if findings in the lab can be generalized to humans. Moreover, it is not clear if vancomycin will be studied in humans since the medical community has sought to limit the use of the drug to fight severe infections such as MRSA (methicillin-resistant Staphylococcus aureus) and penicillin-resistant pneumococci. [4]

The investigators at the University of Arizona, Yale University, and University of Bayreuth are to be congratulated on increasing our understanding of the role of Lyme disease spirochete motility.

References:

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