Bacterial Biofilm in Lyme Disease

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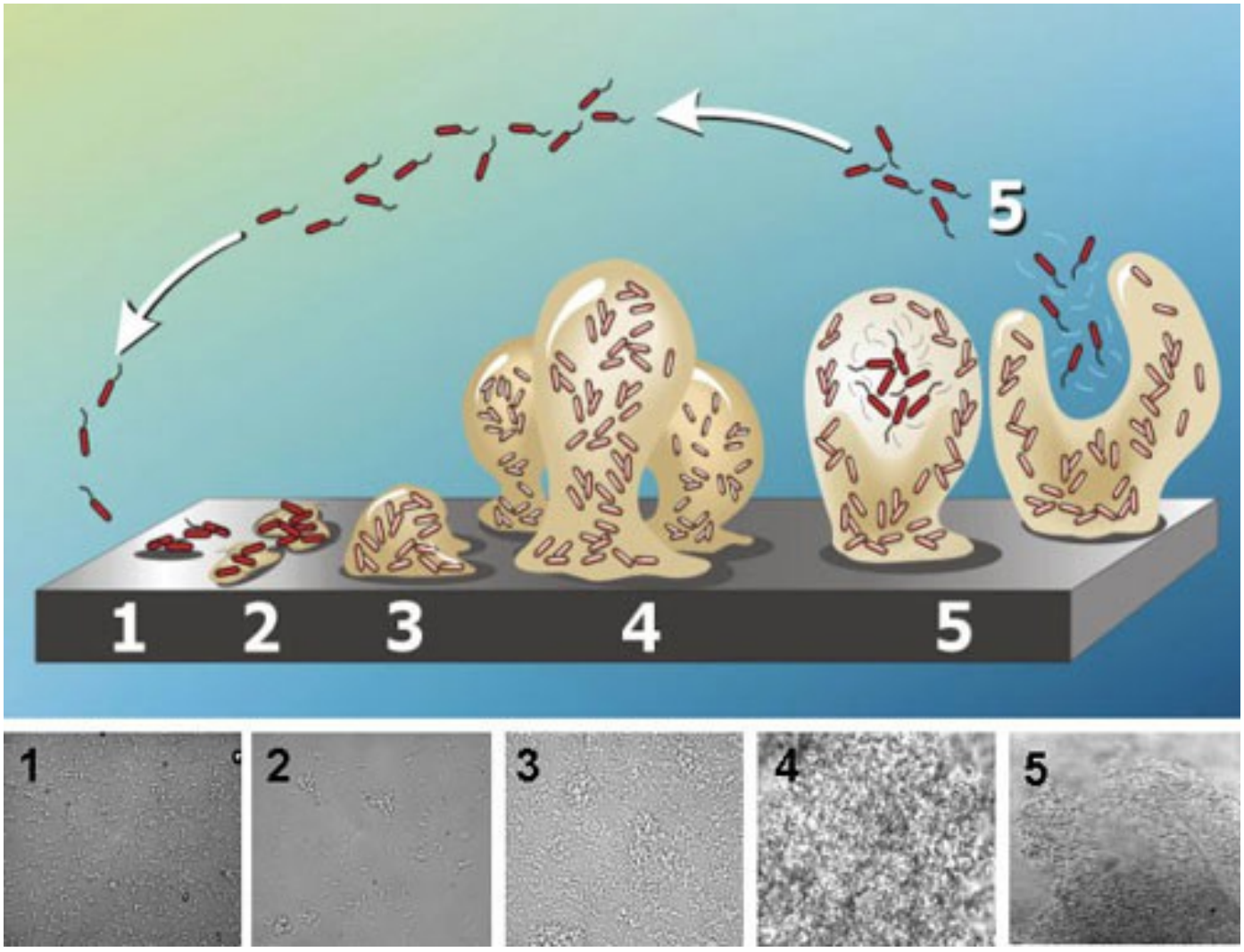
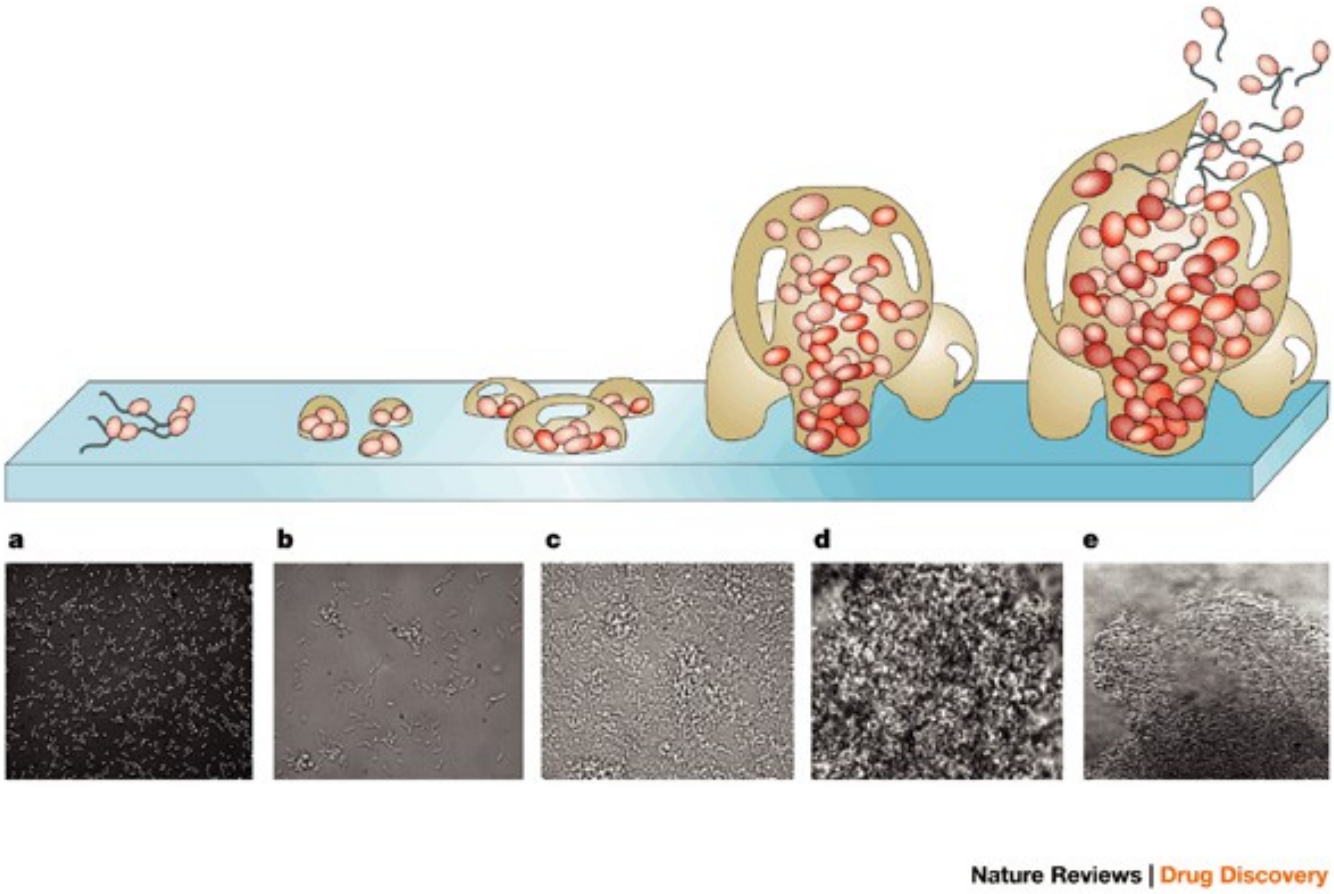
Biofilm is a sticky, viscous negatively charged substance similar to "bacterial slime", composed of mucopolysaccharides and DNA, and stabilized by minerals and probably heavy metal molecules. Placque found on teeth surfaces is a biofilm. Biolfim adheres to aqueous environmental surfaces like vascular endothelium and proliferates. Most types of bacteria secrete some form of this substance which allows them to dwell in the vasculature and extracellular matrix of tissues while also living in a community. By utilizing cell adhesion molecules, the bacteria bind to surfaces, "seed", and form new colonies allowing for continued proliferation

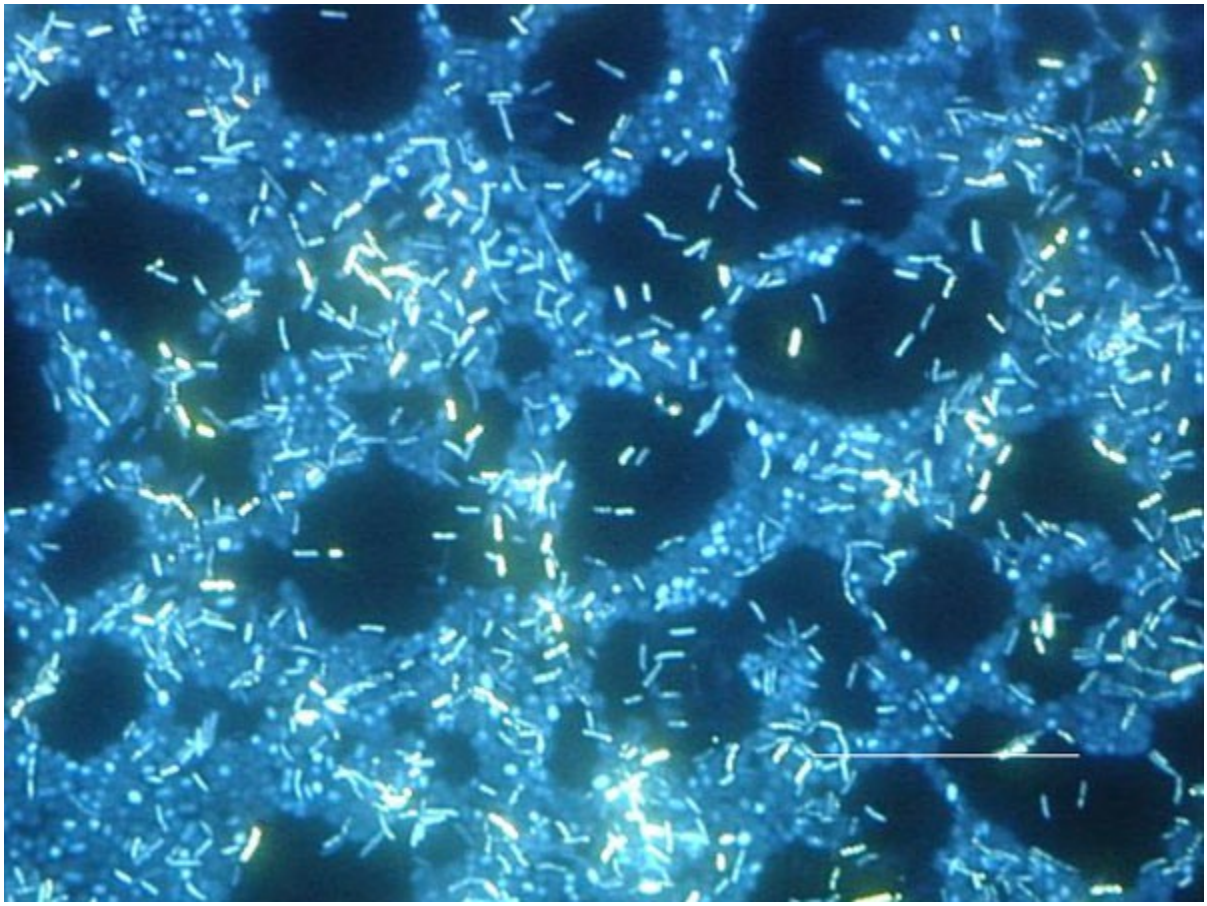




A biofilm community can be comprised of more than one bacterial species (and viral species) that cohabitate and engage in "quorum sensing", and evolutionarily old form of bacterial communication. This is important as we begin to unravel the mysteries encased within the complicated architecture of biofilm. Biofilm resembles "cheese cloth" where it is negatively charged, loose, fluid and anchored at certain places by positively charged ions including: calcium, magnesium, mercury, lead, etc... This may be why when a Lyme Disease patient undergoes heavy metal chelation, they often experience an exacerbation of symptoms. Chelation of minerals and metals essentially destabilizes the biofilm, rendering the inhabiting bacteria more vulnerable to the hosts' immune system and antimicrobials. Additionally, a recent study demonstrated that bacteria actually sense the presence of ammonia which ultimately regulates the social behavior of species contained within the biofilm community. The ability to sense ammonia leads the microorganisms to nutritional sources such as proteins which are nitrogen containing molecules so that feeding can take place.

Dr. Alan MacDonald, a highly regarded Lyme Disease researcher in New York, demonstrated that ***Borrelia*** species not only produce biofilm, but can live in the community in any form (i.e., spirochete, L form, spheroblast, cyst). Additionally, other zoonotic bacteria such as ***Babesia, Bartonella, Ehrlichia, Anaplasma***, and ***Mycoplasma*** species inhabit these communities as well. The biofilm is used to both protect the bacteria from the hosts' immune system, while also serving as a nutritional reservoir in times of harsh environmental conditions. It's a very evolutionarily old and efficient way to ensure that many bacteria of a certain species survive, thrive and replicate. Essentially, it is "bacterial commune living."

The biofilm can adequately prevent antibiotics from reaching pathogenic bacteria and this may account for some people developing chronic Lyme symptoms. The film is effectively protecting many bacterial species that can later escape the community, reproduce and move on to inhabit other tissues.



Currently, it is not scientifically known how to permanently degrade the biofilm, however, it is known that proteolytic enzymes are very effective at dissolving mucopolysaccharides. Therefore, a treatment plan rich in enzymes, n-acetylcysteine and lactoferrin may be helpful in biofilm degradation. Additionally, as the biofilm diminishes, toxins secreted or excreted by bacteria that are contained within the matrix, are then released into the bloodstream often causing a symptom flare. Remnants of the sticky biofilm probably facilitates toxins adhering to tissue surfaces and blood vessel endothelium, forming viscous (thick) or hypercoagulable blood. This is a common laboratory finding that we see in chronically ill patients.

There is exciting new research in molecular biology and biomedical engineering which directly applies to the tick borne bacteria and I am certain that new insights regarding the clinical significance of biofilms is sure to follow. Montana State University, the University of Washington and the University of New Haven in Connecticut, are at the forefront of this research. In fact, a wound care center in Texas is already employing biofilm degradation techniques with reported success in faster wound healing, especially with application of Manuka honey