



The World of Bacteria and Biofilms

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As humans, we are consistently exposed to a variety of dangers from earthquakes to hurricanes and flooding as well as increasing environmental pollutants and new emerging diseases. One of the most relevant players in these emerging threats are the various forms of bacteria we encounter in our environment. These nefarious bugs take on an ever-changing landscape each day. It has taken humans millions of years to evolve our genetic makeup whereas most bacteria can alter their genetic morphology in weeks. This gives them a tremendous advantage in attacking us as fellow inhabitants of the earth.

BACTERIA OUT-SMARTING ANTIBIOTIC MEDICATIONS

Most recently there is a massive growing concern surrounding the resistance of bacteria to our currently available antibiotic medications. Many factors in our environment such as our overuse of these medications, along with the bacteria's genetic advantage, are making this a growing concern. In fact, at the recent World Economic Forum in Davos, Switzerland, it was announced that 74 drug makers and 9 industry groups signed a groundbreaking agreement to work with governments and each other to prevent and improve the treatment of drug-resistant infections. The reason for these resistant infections are many and include overuse of antibiotics both by doctors and the livestock industry, as well as many other causes which have been written about at length. A much less

commonly known reason and a major factor in these diseases is the formation of what is called Biofilm or "Slime"

BACTERIAL BIOFILM

Bacterial Biofilms are little communities of bacteria that form, attached to a surface which helps them to survive as a group. Much like people, bacteria have found that they are more likely to survive as a community through the division of labor. Working together in this way requires communication and cooperation. Bacterial Biofilms form on many different types of surfaces from hot tubs to our teeth and most importantly on critical medical devices like implanted heart valves and catheters. In nature they can serve as an important part of the food chain in rivers and streams

or on glaciers and can form on any surface including surfaces on the inside of our bodies. So even though they are ubiquitous in external environments, they seem to contribute greatly to disease within and on the body.

BIOFILMS MORPHING INTO SUPER BUGS

Biofilms have great significance for public health because biofilm associated bugs are dramatically less susceptible to antibiotics. This is because the bacteria are protected by a sugar (polysaccharide) layer which they build over themselves. The bugs also begin to share DNA and inherit resistance factors that other bugs have acquired. Over time, the community of bacteria becomes stronger and can shed what are called secondary pathogens or superbugs that are hard to test for and hard to treat. The most common day-to-day incidence of biofilm is seen in plaque on the teeth. This is why mechanical brushing and teeth cleaning are so important to disrupt the biofilm. Simple washing or mouthwash is not enough.

More serious diseases occur when biofilm forms on medical devices such as heart valves, pacemakers, contact lenses, prosthetic joints, and breast implants. Often times, the only way to treat the condition is to remove the device - which can be very invasive. Once the bacteria has attached to the device, it is very difficult for anything including our immune systems to remove them. This can pose clinical problems when taking care of patients as sometimes the patient is fine for weeks or months while on suppressive antibiotics but once they are stopped, the biofilm colony thrives and the clinical infection returns again - requiring the device to be removed.

Biofilms also seem to play a big role in delayed wound healing. Often time open wounds that are being treated conservatively with

antibiotic ointment exhibit slow healing due to biofilm forming a low-grade infection. Until the biofilm is removed, the wound fails to heal.

On our teeth, it has been shown that periodontal disease is caused by biofilm bacteria. In addition, this has led researchers to believe that the biofilms in the mouth can gradually spread to the moist surfaces of the circulatory system - leading to higher incidence of strokes and heart attacks in people with dental problems. Researchers at the University College in London have shown that elderly people who have lost their teeth have a 3 fold greater risk of memory loss and dementia. They are attributing this to biofilm formation in the brain.

It is fascinating to note all of the discoveries that show how the bacteria grow in groups and maintain their colony with micro-fluidic channels for nutrients and for waste excretion very much like a small city. The unfortunate problem researchers face is the challenge of how to disrupt the biofilm within the body or on implantable devices. Traditional or high dose antibiotics don't seem to work and other options have not panned out.

As we continue to gather data from patients who recover from these biofilm related infections, we are hopeful that more sophisticated technologies for detecting and treating these conditions will emerge. In the meantime, it is important to remember that biofilm related infections can pose new challenges to treating infections in all areas of medicine from ear aches to tooth aches.

