BioFilms May Be Why You Are Not Getting Well

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This is not an article advertising cinema selections for biology majors. This is a serious topic in public health that has been extensively researched for many years and yet somehow mostly ignored in the practice of outpatient medicine. Biofilms are the reason you brush and floss your teeth daily (hopefully), why you slip on the rocks at the shallow end of the pond, why we get "food poisoning", and why a heart attack may be related to stress. It's all about those bugs again. I just can't seem to stop writing about the bugs. It's one of those "can't live with them and can't live without them" scenarios.

Biofilms are made by microorganisms (those organisms you can't see with the naked eye) including bacteria, protozoa, algae, yeast and fungi. They form where solids and liquids meet, under acceptable conditions to the particular microorganism and, of course where nutrition is available. So think of the slime that forms on the surfaces of the rocks in the pond – that's a biofilm. They are ubiquitous in nature and have become both friend and foe to us in agriculture, industry and medicine.

Van Leeuwenhoek, in the 17th century, discovered microbial biofilms on tooth surfaces using a simple microscope. Researchers have been studying them ever since. Detailed examinations of these biofilms became possible in the 1930s with the invention of the electron microscope. In the 1970s this technology was used to study dental plaque and slimes in industrial waste systems that were resistant to disinfectants like chlorine. In the case of dental plaque, it became apparent that microorganisms were finding nutrients (our sugar filled mouths) on wet surfaces (our teeth), living in communities and protecting themselves (with self- made slime) from our efforts to eradicate them (tooth brushing). Dental plaque, the soft, sticky film that covers teeth, is a good example of a well-adapted biofilm. It consists of bacteria that, over time, release acid that breaks down tooth enamel causing cavities. If not removed, the biofilm becomes hard and turns into calculus or tarter. This will cause the gums to become tender and swollen. The bacteria hide in the pockets they are co-creating between the gums and teeth. This is early periodontal disease.

I always thought of bacteria as floating around in water, mucous, urine, intestines and blood. But this is only partially true. Free floating microorganisms are said to be in planktonic form. When certain genes are turned on, bugs will adhere to an acceptable wet surface to become a biofilm. They start secreting extracellular polymeric substance (EPS, the slime) that encases them. A maturing biofilm will form multiple layers and attract other bacteria, yeast, parasites, etc. to live with them. The biofilm community is resistant to being easily washed away (the reason why you still have to scrub your pool walls sometimes despite using chlorine tablets; the reason you have to brush your teeth). But get this: these microorganisms within the biofilm can talk to each other. This communication system uses signal molecules and is called quorum sensing. The biofilm offers protected growth to the bugs and gives them heightened resistance to antimicrobial drugs as well as to the human immune responses. Biofilms, compared to being in their planktonic form, make bugs 1000 times more resistant to our antimicrobial drugs. When certain environmental conditions exist, a microorganism can switch on genes to become a "free floater" again and leave the biofilm.

The NIH reports that 80% of microbes live in biofilms vs free forms. Some authorities say that this number is much higher. Biofilms are a major public health threat because we have ignored treating them in the more common settings. We are getting better at treating and preventing dental plaque. We are getting better at treating and preventing biofilm infections on implanted medical devices (catheters, prosthetic joints, mechanical heart valves, pacemakers, contact lenses, IUDs, breathing tubes..) and we are getting better at treating the pervasive Pseudomonas infection/biofilm in the lungs of people with cystic fibrosis. In these scenarios we have put effort into treating not only the infectious bug; we have also begun to attack the biofilms that harbor them.

Infections acquired in the hospital setting (nosocomial infections) are the fourth leading cause of death in the United States. It is estimated that 65% of these infections are due to implanted medical devices (even a simple intravenous catheter). However biofilm infections are the cause of many of our more common conditions: chronic sinusitis (usually a fungal biofilm), chronic bacterial vaginosis and urinary tract infections, unhealing wounds, and chronic middle ear infections to name a few. Now we have an emerging epidemic of stealth infection, mainly Lyme and some other vector borne infections as well as mycotoxin infection from mold. These may be referred to as stealth infections because symptoms and diagnostic testing have not been fully comprehended by the medical community. But another reason for their "stealthiness" is that they seem to "hide" - eluding our immune system and medicinal approaches to eradication. Most infections are easier to treat when caught early. Often now, we miss the diagnosis, treat with improper agents or for an inadequate amount of time – allowing the microorganisms to become biofilms. Then we have a much harder condition to treat.

There are other conditions associated with biofilms that are completely ignored by conventional medicine. It is not often recognized that biofilms also form in the blood. Biofilms in blood have been implicated to cause reduced blood flow to muscles resulting in the symptoms of fibromyalgia and other muscle conditions. Biofilms in the arteries can be dislodged during a release of stress hormones. Freed clumps of biofilm can result in blood clots that can cause heart attack and stroke. Who knew?? Special laboratories can take a blood sample, put it on a slide, stain it and check it for biofilms under a specialized microscope. If biofilms are seen, the organism can be matched via DNA sequencing to known organisms entered in an international database of microorganisms and Viola – a diagnosis!! This makes it possible to identify the organism so that a proper killing agent can be recommended along with a biofilm eroding agent.

The best way to treat biofilms is to prevent them. Teeth brushing, flossing, regular dental cleaning have helped us to maintain much better dental health. Just think of what our teeth would be like if we did not have such a high sugar diet though!!! Creating implantable medical devices that are coated with "antibiotics" or, better yet materials that don't allow the bugs to stick on (silicon with silver or other special coatings).

To treat biofilms once they have formed is an art form at the moment. I imagine your doctor has not given you an antibiotic for your chronic sinusitis AND a biofilm buster. A typical treatment in this office would include a nasal spray to attack the bug (fungal or bacterial) and a nasal spray to break up the biofilm so that the infectious bugs can be exposed. Typically, in treating a chronic infection consideration must be given to the organism causing the infection, the length of time infection has been present, whether biofilm is suspected (or known if above blood test was done), the likelihood that metals are in the biofilm, the treatment so far and how the person has responded and, of course, the age, weight, and constitution of the patient (the host). It is a bit of a game of chess – to start a protocol and see what happens, then try a different protocol and see what happens but eventually there is usually success. And the option of waiting or not recognizing/treating the cause of the symptoms will just allow it to spread further and deeper. Not a good option…

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