CLINICAL RELEVANCE OF BIOFILM PATHOGENS

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Biofilms are microbial communities that live on a surface and embedded within an extracellular polysaccharide matrix.

Interest in biofilms began in the 1970's when scientists studying bacteria in aquatic environments in rivers and streams realized that the vast majority of bacteria in natural habitats actually survive as biofilms rather than as free-floating individuals. Moreover, in this form, the microbial community is capable of responding to its environment in a coordinated fashion resembling multicellular organisms. This is achieved through a mechanism known as quorum sensing which regulates gene expression in response to bacterial population density. Quorum sensing is vital for biofilm development and has also been found to be responsible for regulation of many other aspects of the microbial community including virulence factors and drug resistance which affect the pathogenicity of the organism. Pathogens living in biofilms are able to withstand biocide at concentrations up to 1000 times greater than in its free-floating form. Very similar biofilm development are also seen in fungi.

Biofilm development begins when free-floating microbes come into contact with a surface. A number of these will attach to the surface and stay there. They initially form microcolonies. These then aggregate to form complex 3-dimensional biofilm structures. Microscopic image analyses have revealed the presence of water-channels within biofilms which function as a simple circulatory system within the biofilm, allowing the biofilm to maintain some degree of homeostasis.

In the medical setting biofilm pathogens are responsible for virtually all medical implant related infections such as sepsis from central venous catheters, pace-makers, joint prostheses, and contact lens. Relatively innocuous organisms such as *Staphylococcus epidermidis* and *Candida albicans* are capable of causing infections in the appropriate setting due to their well-developed ability to form biofilms on artificial surfaces. In addition, biofilm pathogens may also colonise and infect native host tissue especially when there is some impairment of the existing defence mechanisms such as in cystic fibrosis.

As our understanding of biofilms broaden, strategies aimed at eradicating biofilm pathogens have focused not just on drugs with enhanced activity against biofilms but also on designing drugs that disrupt biofilm development in the first place to allow our current antibiotics to be more effective.