Background

With advanced medical care, many persons live for extended time periods with foreign materials such as prostheses and catheters within their bodies. In addition, many persons are immunosuppressed by drugs aiming to treat other diseases. This leads to that many bacteria which normally live in harmony with their hosts can cause invasive infections. Many such opportunistic pathogens also have the propensity to attach to foreign materials and to form biofilms. A biofilm is composed of bacteria in a distinct metabolic state, embedded in an extracellular substance composed mainly of carbohydrates. Bacteria in the biofilms are resistant both to host defences and to the actions of antibiotics (1). Thus, if a catheter or prosthesis gets infected, surgical removal of the material is often necessary. Since removal of a prosthesis or catheter is often not without risks, conservative treatment of biofilm-related infections with antibiotics is sometimes tried. However, it is not clear which antibiotics that should be used to treat these infections, since systematic studies are largely lacking.

For bacteria in biofilms, antibiotic susceptibility can be tested using the Calgary biofilm-device (2), which determines the minimal biofilm eradication concentration (MBEC). Though this is an established method it has to be combined with other methods, and MBEC-determination has not been implemented in clinical practice.

Our studies on biofilm

The PhD student Anna Holmberg, who is an infectious diseases specialist, and myself have studied the ability of several Gram-positive opportunistic pathogens to form biofilm in vitro. We have focused on bacteria that have the capacity to infect joint prostheses and to cause infective endocarditis (IE). We have shown that Propionibacterium acnes, which is an important cause of joint prosthesis infections, has the capacity to form biofilms and that this capacity correlates to invasiveness (3). I have also demonstrated that Aerococcus urinae, a cause of IE in elderly men, can form biofilms and that this may be involved in the pathogenesis of the infection (4). Another focus of our previous research has been on Enterococcus faecalis, which is a very important
cause of different infections related to foreign materials and it is known to form biofilm (5). My PhD student Daniel Johansson have demonstrated that biofilm-formation is negatively correlated to invasiveness for this species (6).

We have shown that a combination of ciprofloxacin and rifampicin, an unconventional antibiotic combination used against Staphylococcus aureus biofilm-related infections, is efficient in vitro also against Enterococcus faecalis which is a common cause of joint prosthesis infections (7). We have demonstrated that biofilms of E. faecium in vitro are very resistant to vancomycin which is commonly used to treat such infections. Instead, combinations of daptomycin or tigecycline with rifampicin seem effective (Holmberg and Rasmussen submitted). We have also observed that aged biofilms of E. faecalis and E. faecium have different antibiotic susceptibilities as compared to young biofilms. The effect of commonly used antibiotics such as ampicillin and vancomycin is very low in the aged biofilms (Holmberg and Rasmussen, in preparation).

Magnus Rasmussen, April 2013.

References
7. Holmberg A, Mörgelin M, Rasmussen M. Effectiveness of ciprofloxacin or linezolid in