Sunday Afternoon, October 17, 2010

Biomaterials Plenary Session
Room: Taos - Session BP-SuA

Detecting, Characterizing and Controlling Biofouling

Moderator: S.L. McArthur, Swinburne University of Technology, Australia

3:00pm **BP-SuA1 The Effect of a Polymer Brush Coating on Protein Adsorption, Bacterial Adhesion, and Biofilm Formation**, ***W. Norde***, Wageningen University, University Medical Center Groningen and University of Groningen, the Netherlands **INVITED**

Adsorption of proteins from biofluids is considered to be the first event in the biofouling process. Subsequently, micro-organisms and/or biological cells (e.g. blood platelets, erythrocytes) adhere to the surface and a biofilm may be developed. In this paper, generic principles of the interaction between a polymer brush and indwelling particles (globular proteins; micro-organisms) are explained and illustrated with some experimental results. Furthermore, the influence of a polymer brush on the development and characterization of a biofilm is discussed.

3:40pm **BP-SuA3 Biomaterials-Associated Infections – In Vitro and In Vivo Studies**, ***H. Busscher***, University Medical Center and University of Groningen, the Netherlands **INVITED**

Modern health care is greatly dependent on the use of biomaterials implants and devices for the restoration of function, after trauma, (oncological) intervention surgery or simply wear due to old age. Biomaterials implants surfaces in the human body are prone to infection, as can develop through three distinctly different routes. Peri-operative infection is the best documented route and usually causes early infection of an implant. Also immediate post-operative infection can be a cause of early failure. Late post-operative infections spreading from infections elsewhere in the body have also been described to be a cause for implant infection and failure. Since a biomaterial-associated infection (BAI) is difficult to treat with antibiotics due to the protection offered by the biofilm mode of growth and intra-cellular shelter, the fate of an infected implant often is removal, at great discomfort to the patient and costs to the healthcare system. Frequently even, the condition of a patient does not allow replacement surgery or removal of a device. BAI can be lethal when spreading through the body. Whereas the infection rate of primary implants may be considered low (4-6% on average depending on the implant type), infection rates in revision surgery are much higher around 15%.

Prevention strategies under investigation are numerous, but no generally effective way to prevent BAI has been found. Moreover, prevention of BAI of a primary implant may require different approaches than the prevention of BAI of secondary implants after treatment of BAI.

Numerous prevention strategies based on biomaterials surface modification that discourage microbial adhesion and biofilm formation have been forwarded in the literature, but none of them have clinically provided a breakthrough. The lack of a clinical breakthrough is partially due to the low incidences of BAI (though still being unacceptably high), requiring large numbers of patients to be enrolled in a study. Therefore, novel evaluation technologies are required that indicate whether new preventive strategies work under in vivo conditions.

Bioluminescence and Fluorescent Imaging are new evaluation technologies (BLI and FLI) that offer the opportunity to observe the *in vivo* course of BAI in small animals without the need to sacrifice animals at different time points after the onset of infection. BLI is highly dependent on the bacterial cell metabolism which makes BLI a strong reporter of viable bacterial presence. Fluorescent sources are generally more stable than bioluminescent ones and specifically targeted, which renders the combination of BLI and FLI a promising tool for imaging BAI.

In the concept of the race for the surface, successful implant coatings should favour tissue integration over microbial colonization. This suggests that new prevention strategies abandoning the concept of mono-functional fully non-adhesive, tissue-supporting, or immune-friendly coatings may have to be developed on the basis of multi-functional coatings better mimicking natural tissue. The efficacy of macrophages in removing adhering bacteria from a surface for instance, is much higher on cross-linked PEG coatings than on glass because bacteria do not switch on their natural defences on such highly hydrated coatings exerting only weak interaction forces, while macrophages are less immobilized for the same reasons. Polymer brush coatings, designed with an occasional RGD-group for instance, keep their non-adhesive functionality, while at the same time supporting tissue integration.

The coming decade is without becoming the decade of effective antimicrobial coatings for biomedical implants and devices. Societal pressure is huge and with the current developments of new evaluations technologies and better insights in the different functionalities with which effective coatings should be equipped, clinical breakthrough should be within reach.

4:20pm **BP-SuA5 Engineered Surface Designs for Directed Attachment on Topographies**, ***A.B. Brennan***, *C.M. Magin*, University of Florida, *L.K. Ista*, University of New Mexico, *G.P. Lopez*, Duke University, *M.E. Callow*, *J.A. Finlay*, *J.A. Callow*, University of Birmingham, UK **INVITED**

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