Antimicrobial coatings for Central Venous Catheters (CVC)

Alessio Piermattei*, Olga Crespo Biel**, Edith van den Bosch*, Onko-Jan Gelling†, Marc Hendriks†
*DSM Ahead, P.O. Box 18 6160 MD Geleen, The Netherlands
**DSM Dyneema, Mauritslaan 49 6129 EL Urmond, The Netherlands
†DSM Biomedical, P.O. Box 18 6160 MD Geleen, The Netherlands
Alessio.Piermattei@dsm.com

Introduction

In the US, physicians insert more than 5 million central venous catheters (CVC) every year. Unfortunately, the use of CVC is associated with adverse events that are both hazardous to patients and expensive to treat. Patients who require central venous catheterization are at high risk for catheter-related thrombosis. Moreover, catheter-related bloodstream infections (BSI) are common, costly and potentially lethal. Catheter-related infections are thought to arise by several mechanisms: infection of the exit site, followed by migration of the pathogen along the external catheter surface; contamination of the catheter hub, leading to intraluminal catheter colonization and thus spreading infection along the bloodstream, and hematogeneous seeding of the catheter. It is observed that CVC-related thrombosis and CVC-related infections can not be seen as separate entities, the need of designing an anti-microbial coating as well as a hemocompatible coating is needed. We address this problem by the development of non-eluting AM coating for intravascular devices by the polymerization between a biguanide (BiG) comonomer and 1-vinyl-2-pyrrolidone (NVP). The manner to achieve adequate activity and coating stability is grafting the biguanide copolymer into the polyvinylpyrrolidone(PVP)-based coating matrix.

Antimicrobial test

Antimicrobial (AM) activity of polyethylene terephthalate (PET) film coated with coatings containing different concentrations of biguanide (TC IV-01) was checked against *Escherichia coli* ATCC 11105 at concentration of 10^5 CFU/mL. As can be observed from figure 1, the coating resulted in bactericidal activity against *Escherichia coli* ATCC 11105 at different concentration of biguanide a final concentration of 10^5 CFU/ml. No bactericidal activity was observed for the uncoated PET films and for coating only PVP.

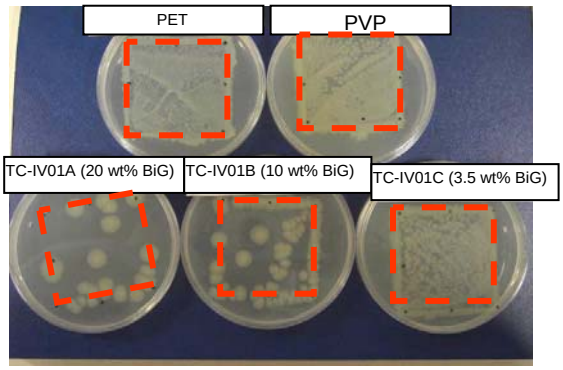

Figure 1: *AM activity at the surface of different coated films containing different concentrations of biguanide (in the form of PVP-co-Big) against 10^5 CFU/mL Escherichia coli ATCC 11105 after 24 h incubation at 37ºC. The red square is a guide for the eye.*

Hemocompatibility test

Six samples each from different coated catheter (PVP, TC IV-01 B, TC-IV01 C), and uncoated samples (blank) were tested for their hemocompatibility by using an *in vitro* Chandler-Loop model with fresh human whole blood. This model serves to investigate the effects of artificial surface to initiate the different cascade reactions of the human hemostatic system (coagulation, cell alteration, complement and inflammation). The results of the hemocompatibility tests based on the parameters cell count, TAT, b-Thromboglobulin, PMN, Elastase, SC5b-9 and hemolysis showed that all the DSM coatings (PVP, TC IV-01 B, TC-IV01 C) had a good hemocompatibility.

Summary

We showed the development of a novel non-leachable antimicrobial and hemocompatible coating for CVC applications based on biguanide moiety.