INTRODUCTION

Biomaterial-associated infection is a common and serious complication in long-term tissue-biomaterial interactions. For example, established bacterial biofilms at the insertion sites of central venous catheters may lead to catheter-related blood stream infections with attributable mortality rates. There is a need for novel products/strategies to prevent and treat soft tissue infection. That in turn requires relevant in vivo models and the real clinical setting, during product development.

This poster describes the results of a study that was undertaken to assess the in vitro efficacy of an antimicrobial dressing with soft silicone adhesive against bacterial growth at the insertion site of a catheter.

AIMS

The aims were to study if the antimicrobial compounds in the dressing (chlorhexidine and silver sulphate) can diffuse from the soft silicone layer and through the agar whereupon a piece of a catheter has been placed below the dressing. Is, can bacterial growth be prevented in the vicinity of the dressing where it has not been in direct contact with the agar surface?

METHODS

A diffusion model was established. Briefly, pieces of intravenous catheters (length 2 cm) were placed on blood agar plates containing simulated wound fluid (SWF) to mimic an insertion site. A circular dressing piece (18 mm diameter) was applied on top of the catheter. The assemblies were then incubated at 35°C ± 2°C for 24 hours. For comparison, the same test was performed using Mueller Hinton agar, the type of agar specifically used for testing diffusion of antimicrobial compounds (Figure 1).

On the following day, the dressing and catheter were removed and Staphylococcus epidermidis (ATCC 19999; 1.5 × 10^8 CFU/mL) was spread over the plate and incubated for an additional 24 hours at 35°C (25 µl bacterial solution to 4.5 cm agar plates). The plates were photo-documented over the plate and incubated for an additional 24 hours at 35°C (25 µl blood agar plates with added serum proteins more closely resemble the environment of an actual intravascular insertion site than Mueller Hinton agar. Clinically relevant methods will have a better predictability which is fundamental for products with antimicrobial activity, since lack of activity in the clinical setting can contribute to the rise of microbial resistance.

CONCLUSION

The findings of this in vitro study demonstrate that the antimicrobial dressing with soft silicone adhesive has the ability to prevent bacterial growth on the surface mimicking an intravenous site and also under the catheter covered by the dressing (i.e. even where the dressing is not in direct contact with the surface). This was shown on both Mueller Hinton agar and simulated wound fluid containing horse blood agar. The latter was developed to study antimicrobial activity in a more clinically relevant "tissue" condition to increase the predictability that the dressing will work as intended in the clinical setting.

REFERENCES


In vitro study of the efficacy of a novel antimicrobial dressing with soft silicone adhesive in a diffusion model mimicking a catheter insertion site

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DISCUSSION

The test method developed is called “Diffusion method” and is a modification to the Kirby Bauer method, which is widely used to study antibiotic susceptibility. This method assesses the antimicrobial activity qualitatively, i.e. it offers rapid visual screening. Zones of inhibition of bacterial growth can be seen as clear zones on the agar plates. In this present study two different agar types were used; Mueller Hinton agar (used in Kirby Bauer method) and horse blood agar containing SWF. The antimicrobial dressing with soft silicone adhesive was found to inhibit bacterial growth on both agar types tested. The zones were clearly smaller on blood agar than Mueller Hinton agar plates, showing that the choice of medium is crucial to the test result. The blood agar plates with added serum proteins more closely resembled the environment of an actual intravascular insertion site than Mueller Hinton agar. Clinically relevant methods will have a better predictability which is fundamental for products with antimicrobial activity, since lack of activity in the clinical setting can contribute to the rise of microbial resistance.

RESULTS

No bacterial growth was detected under the catheter and a clear ZOI was observed on both blood agar and Mueller Hinton agar. The diameters of the zones were markedly reduced on the blood agar compared to Mueller Hinton agar (see Table 1). Lack of growth below the catheter and a ZOI indicate diffusion of the antimicrobial compounds through agar.

Table 1: The diameter of the zone of inhibition (ZOI) was measured and the mean and standard deviation (Stdev) were calculated for three replicates and their duplicate perpendicular measurements.

<table>
<thead>
<tr>
<th>Agar</th>
<th>Mean (mm)</th>
<th>Standard deviation</th>
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<tbody>
<tr>
<td>Blood agar + Simulated wound fluid</td>
<td>18.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Mueller Hinton agar</td>
<td>27.3</td>
<td>5.0</td>
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Figure 1: Experimental set-up - 2 cm cut catheter piece with a 18 mm wide dressing on top were applied on horse blood + Simulated wound fluid (SWF) agar plate (left) and Mueller Hinton agar plate (right).

Figure 2: Plates were photographed after incubation for 24 hours with dressing and catheter followed by removal of the same and incubation for another 24 hours with S. epidermidis. One of three replicates is shown. Horse blood + Simulated wound fluid (SWF) agar plate (left) and Mueller Hinton agar plate (right).