Askina® Calgitrol® Ag

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In Vitro Evaluation of the Antimicrobial Effectiveness and Moisture Binding Properties of Wound Dressings

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Background and objective

Abstract: A variety of silver-coated dressings and some impregnated with other chemicals are now available in the market; however, there have been few studies analyzing their comparative efficacies as antimicrobial agents. Besides antimicrobial properties, the ability to absorb moisture is also an important factor for healing. Bolton et al. suggested that the use of more moisture-retentive dressings generally supports faster healing compared with less moisture-retentive dressings. The objective of this study is to evaluate the antimicrobial effectiveness of five commercially available antimicrobial dressings in vitro. The moisture penetration of each dressing will also be investigated.

Method

Five commercially available silver-containing and chlorhexidine dressings, Urgotul® SSD, Bactigras®, Acticoat®, Askina® Calgitrol® Ag and Aquacel® Ag were tested to determine their comparative antimicrobial effectiveness in vitro against five common wound pathogens, namely methicillin-sensitive and -resistant Staphylococcus aureus, Bacillus subtilis, Escherichia coli and Pseudomonas aeruginosa. Mepitel®, a flexible polyamide net coated with soft silicone, was used as a control. The zones of inhibition and both the rapidity and the extent of killing of these pathogens were evaluated, as well as water vapour absorption capacity.

Corrected Zone of Inhibition Test

The antimicrobial effect of each dressing was tested using corrected zone of inhibition method. The bacterial isolates were grown in broth for 4 to 6 h, and the broth was used to inoculate Muller-Hinton agar plates to form a confluent lawn. The various wound dressings (about 1 cm^2) were applied to the center of each lawn, and all plates were incubated for 24 h at 37°C. The inhibition zone surrounding the tested dressing was then determined.

Bactericidal Activities of Antimicrobial Dressings

In order to determine the onset and duration of antimicrobial activity of each dressing, bactericidal activities at different time points were determined by bacterial broth culture method which was adopted from Fraser et al. with some modifications.

Wound Dressing Water Vapor Absorption

Dressings (about 9 $inch^2$) were prepared in an aseptic manner and precisely weighed. Each dressing was placed in a desiccator pre-equilibrated with salts to make the relative humidity a desired value. Potassium sulfate or potassium acetate powder was placed in a desiccator to achieve a percentage relative humidity of about 90% and 20% at 30°C, respectively, as reported by Greenspan. After 30 min, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 12, 24, 48 and 72 h, each dressing was taken from the desiccator using sterile forceps and again precisely weighed. The equilibrium moisture absorption was determined by the percentage weight change.

Results

Zone of inhibition test

Corrected zone of inhibitions (mm) generated by topical antimicrobial dressings.

Microorganism	Urgotul® SSD	Bactigras®	Acticoat®
S. Aureus	1.41 ± 0.86	1.13 ± 0.42	13.30 ± 0.78
MRSA	0.19 ± 0.11	0.36 ± 0.33	6.69 ± 0.14
B. Subtilis	2.39 ± 2.11	7.12 ± 1.24	10.98 ± 0.49
P. Aeruginosa	9.05 ± 3.34	0	17.62 ± 4.82
E. Coli	6.44 ± 1.22	0.78 ± 0.16	15.98 ± 0.84

Microorganism	Askina® Calgitrol® Ag	Aquacel® Ag	Mepitel®
S. Aureus	24.33 ± 3.12	12.97 ± 0.85	0.00
MRSA	8.11 ± 4.33	1.84 ± 0.95	0.00
B. Subtilis	5.62 ± 1.48	6.69 ± 1.39	0.00
P. Aeruginosa	21.08 ± 0.89	22.56 ± 1.77	0.00
E. Coli	12.42 ± 0.69	10.58 ± 0.47	0.00

Conclusion

Acticoat® and Askina® Calgitrol® Ag produced the largest zones of inhibition, which may be due to the high concentration of silver contained in these dressings (105 mg / 100 cm^2 and 141 mg / 100 cm^2, respectively) compared with 3.75% of silver sulfadiazine in Urgotul® SSD and 0.5% chlorhexidine in Bactigras®.

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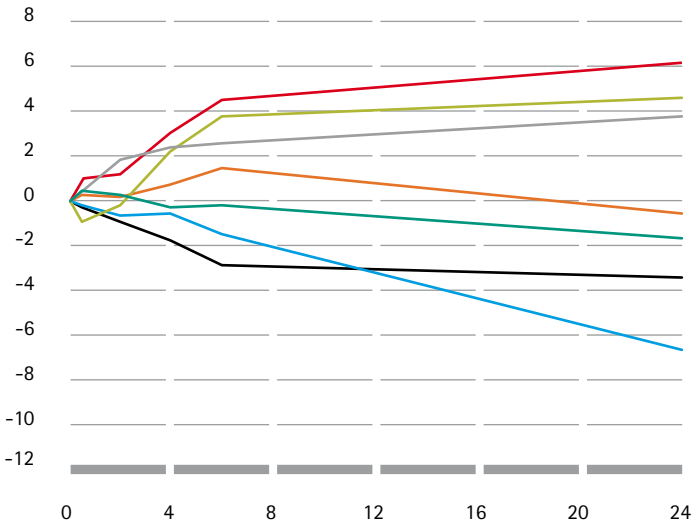
Results

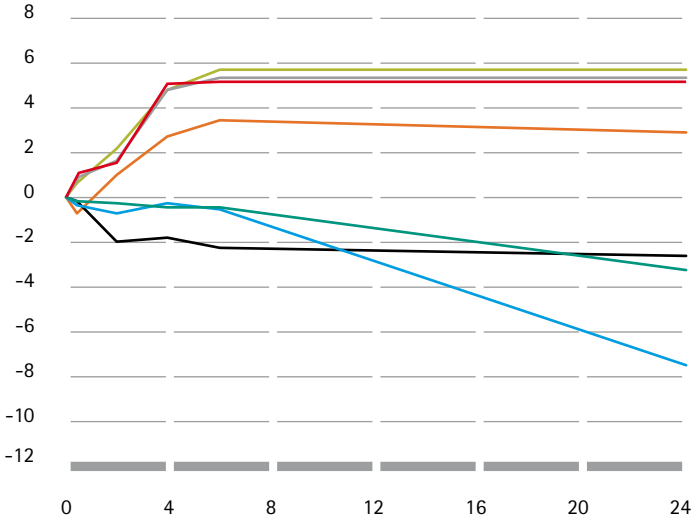
Bactericidal Activities of Antimicrobial Dressings

Bactericidal activity was indicated by a reduction in bacterial counts presented as log10 c.f.u. (colony forming units) ml-1over time. These curves also indicated the rate of bacterial killing and provided an additional index of efficacy against the described isolate. The normal growth rate of each organism was represented by the growth control and that of the Mepitel® dressing, which contained no antimicrobials.

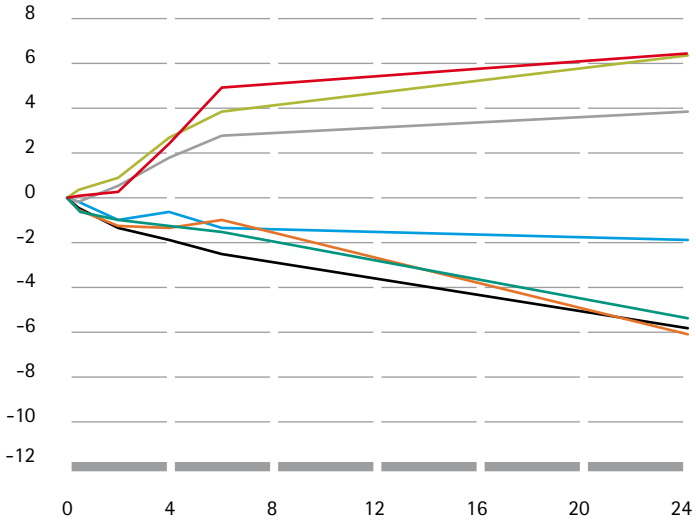
(a) Methicillin-sensitive Staphylococcus aureus (ATCC 6338P)



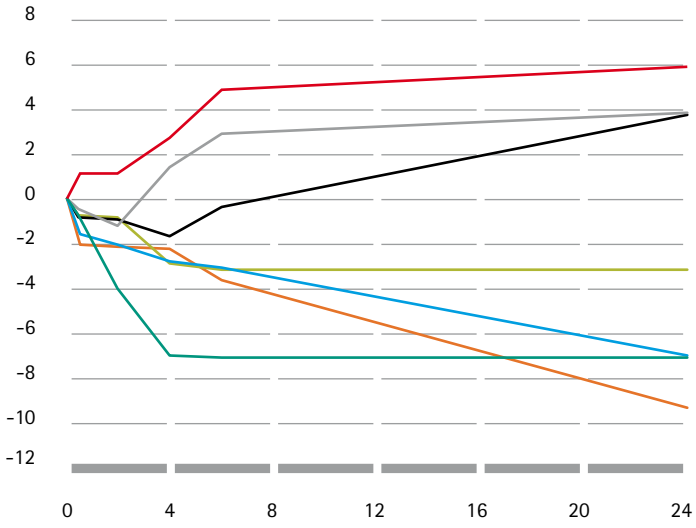
(b) Methicillin-resistance Staphylococcus aureus (ATCC 25923)



(c) Bacillus subtilis (ATCC 6633)



(d) Pseudomonas aeruginosa (ATCC 27853)



Acticoat®
Askina® Calgitrol® Ag
Urgotul® SSD
Aquacel® Ag
Bactigras®
Mepitel®
growth control

Askina® Calgitrol® Ag

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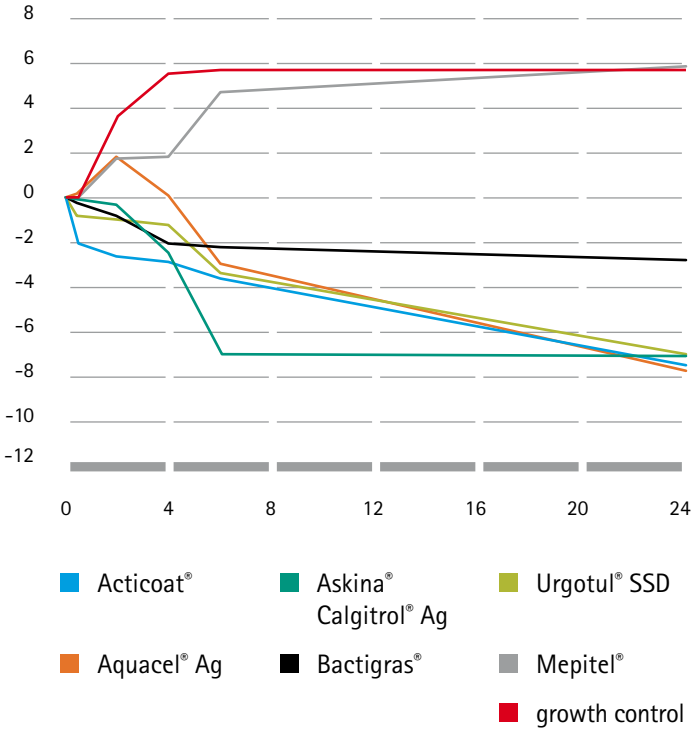
(e) Escherichia coli (ATCC 25922)



Conclusion

Overall, Acticoat® seemed to be the most effective dressing against these five tested organisms, especially with Gram-positive bacteria, whereas Urgotul® SSD and Bactigras® seemed to have a lower antimicrobial effect compared with the other dressings. For the Gram-positive bacteria, S. aureus (Figure 1a,b) and B. subtilis (Figure 1c), the Acticoat® dressing exerted maximal bactericidal activity, achieving more than a 4 log reduction of bacterial growth after 24 h. The killing patterns of S. aureus and B. subtilis by silver dressings were similar to MRSA, except for Aquacel® Ag, which slightly reduced both S. aureus and B. subtilis counts but had no effect on MRSA.

With P. aeruginosa (Figure 1d), Acticoat®, Askina® Calgitrol® Ag and Aquacel® Ag exhibited a good bactericidal effect.

The maximal killing of P. aeruginosa was achieved at 4 h with Askina® Calgitrol® Ag and the reduction in bacterial counts was sustained. The killing pattern for E. coli (Figure 1e) by Askina® Calgitrol® Ag was similar to that for P. aeruginosa except for the maximal killing, which was found at 6 h.

All dressings exhibited bactericidal activity and achieved more than a 4 log reduction of E. coli (Figure 1e) except for Bactigras®, which had a less pronounced effect.