

Type	Improved wound healing	Antimicrobial Activity	Tolerability and Cytotoxicity	Page
In-vitro		●		30/32

Antimicrobial properties of ten silver-containing dressings

Stephan Thomas, B.Pharm., Ph.D., F.R. Pharm. S. Pamela McCubbin B.Sc. Ph. D
Journal of wound care vol 12, No 8, September 2003

Background and objective

The aim of this in vitro study was to determine the ability to release silver in sufficiently high concentrations to exert a significant antimicrobial effect of 10 silver containing dressings.

Method

Test organisms

Three standard organisms were used: a Gram-positive bacteria *S. aureus* (ATCC 6538P), a Gram-negative organism, *E. Coli* (ATCC 8739), and a yeast, *C. Albicans* 'ATCC 2091). The test methods used during this study were designed to compare the performance of the dressings under different simulated conditions of use. A non-woven swab was used as a negative control and Acticoat® as a positive control.

Method 1: Zone of Inhibition Test

Samples of each dressing were placed upon agar plates inoculated with 0.2 ml of a long-phase broth culture of each test organism. After incubation, the zone of inhibition was evaluated: a clear region around the perimeter of the test sample which was free of bacterial growth. The zone of inhibition method simulates the use of the dressings on lightly exuding wound and predicts the ability of dressings to kill or prevent bacterial growth in this situation.

Method 2: Challenge test

To portions of each dressing measuring 40mm x 40mm were added 0.2 ml of a long-phase culture of each test organism. After 2h of incubation the dressing samples were transferred into Oxoid solution and vortexed to remove any viable organisms remaining in the dressing. Serial dilutions were performed and the number of viable organisms present determined using the standard surface counting technique.

The microbiological challenge test provides an indication of the ability of each dressing to kill or prevent the growth of predetermined numbers of bacteria applied directly to it in the form of suspension, to reflect the action of the dressing when applied to more heavily exuding wound.

Method 3: Microbial Transmission Test

In this test the strip of dressing forms the bridge between two separate agar blocks in a Petri dish: one sterile, the other inoculated with the test organism. The third test determines the ability of bacteria to survive on the dressing surface and migrate along it. The positive result suggests that it is possible that microorganisms could be transported laterally out of a contaminated wound onto the surrounding skin.

Method 4: Silver Content of the Dressing

The total extractable silver content of each dressing was determined following acid digestion of the sample using the inductively coupled plasma optical emission spectroscopy (ICP – OES).

Results

Method 1: Summary of Zone of Inhibition Test Results

	S. Aureus (ATCC 6538P)	E. Coli (ATCC 8739)	C. Albicans (ATCC 2091)
Group A (Score 3) Products that show evidence of sustained activity over two or more days	Acticoat Aquacel Ag Calgitrol Ag Contreet H Silverlon	Acticoat Calgitrol Ag Contreet H Silverlon	
Group B (Score 2) Products that produce a well-defined zone of inhibition at on time interval	Arglaes Powder Silvasorb	Aquacel Ag Arglaes Powder	Acticoat Arglaes Powder Calgitrol Ag Contreet H Silvasorb Silverlon
Group C (Score 1) Products that produce no well-defined zone of inhibition in this test	Actisorb Avance Contreet Ag	Actisorb Avance Contreet Ag Silvasorb	Actisorb Aquacel Ag Avance Contreet Ag

Askina® Calgitrol® Ag has a sustained antimicrobial activity during two or more days.

Askina® Calgitrol® Ag

Type	Improved wound healing	Antimicrobial Activity	Tolerability and Cytotoxicity	Page
In-vitro		●		30/32

Method 2: Summary of microbial challenge test results

	S. Aureus (ATCC 6538P)	E. Coli (ATCC 8739)	C. Albicans (ATCC 2091)
Group A (Score 4) Products that demonstrate marked antibacterial activity after 2 hours incubation	Acticoat Calgitrol Ag	Acticoat Calgitrol Ag Contreet H Silverlon	Acticoat Calgitrol Ag Contreet H Silverlon
Group B (Score 3) Products that demonstrate marked antibacterial activity after 4 hours incubation	Silverlon	Contreet H Aquacel Ag Silvasorb	
Group C (Score 2) Products that demonstrate marked antibacterial activity after 24 hours incubation		Actisorb	
Group D (Score 1) Products that demonstrate limited evidence of antibacterial activity after 24 hours incubation	Aquacel Ag Contreet H Contreet Ag Silvasorb		Contreet Ag Aquacel Ag Silvasorb
Group E (Score 0) Products that demonstrate no convincing evidence of antibacterial activity after prolonged incubation	Actisorb Avance	Avance	Actisorb Avance

Rapid and wide range antibacterial activity: Calgitrol® and Acticoat® are the only dressings active within first 2h after application, against all 3 tested microorganisms.

Method 3: Microbial Transmission Test

Product	S. Aureus (ATCC 6538P)	E. Coli (ATCC 8739)	C. Albicans (ATCC 2091)
	Transfer +/-	Transfer +/-	Transfer +/-
Acticoat	-	-	-
Actisorb	+	+	-
Actisorb *	-	-	-
Avance	+++	+++	+++
Aquacel Ag	-	-	-
Askina Calgitrol Ag	-	-	-
Contreet Ag	-	-	-
Contreet H	-	-	-
Silvasorb	-	-	-
Silverlon	-	-	-
Control	+++	+++	-

Each + indicates the results for a single test strip
* Only the inner core of the Actisorb was used in this test

Negative result for Askina® Calgitrol® Ag signifies the absence of risk of transmission of microorganisms through the dressing.

Askina® Calgitrol® Ag

Type	Improved wound healing	Antimicrobial Activity	Tolerability and Cytotoxicity	Page
In-vitro		●		30/32

Method 4: Silver content of the dressing and the total performance score

Product	Batch No	Ag content (mg/100 cm ²)	Total performance score
Silverlon	102S02-01	546	19
Askina® Calgitrol® Ag	131-71	141	20
Acticoat	010814A-08 020214A	109 101	20
Contreet Ag	74853.01	47	9
Contreet H	31576B 267462 344046	31.2 32.4 31.4	13
Aquacel Ag	2H55863	8.3	10
Silvasorb	2082001	5.3	9
Actisorb Silver 220	0138-03 0135-04	2.9 2.4	2
Avance	1106947	1.6	0
Arglaes powder	527027	6.887 mg/g	0

The silver content of tested dressings indicates that major differences exist between these products, with values ranging from 1.6 to 546mg/cm². Also included are the total scores achieved by each dressing in the various laboratory tests. Askina® Calgitrol® Ag has the second highest silver content and the best overall performance score (with Acticoat®).

Conclusion

Askina® Calgitrol® Ag, which contains a high concentration of silver, performed very well in all tests. The reason for this is likely to be that the silver, already available in the ionic form, is concentrated on the surface of the dressing in a hydrophilic coating which facilitates its rapid release.