Cytotoxicity of Silver-Containing Dressings in Diabetic Patients

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Background

- **Silver dressing**
  - **Antimicrobial activity**
    - Gram positive bacteria including MRSA
    - Gram negative bacteria
    - Fungus
  - **Used in chronic wounds**
    - Diabetic foot
    - Burn
    - Sore
Background
Background

Antibacterial Activity

Cytotoxicity

Image of silver ingot with "5009.999 SILVER 509186" embossed on it.
Effect of Different Wound Dressings on Cell Viability and Proliferation

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Background: Many new dressings have been developed since the early 1980s. Wound healing comprises cleansing, granulation/vascularization, and epithelialization phases. An optimum microenvironment and the absence of cytotoxic factors are essential for epithelialization. This study examines the effect of extracts of different wound dressings on keratinocyte survival and proliferation.

Methods: Keratinocyte cultures were exposed for 40 hours to at least three extracts of each of the following wound dressings, which were tested in octuplicate: Acticoat, Aquacel-Ag, Aquacel, Algisite M, Avance, Comfeel Plus transparent, Contreet-H, Hydrasorb, and SeaSorb. Silicone extract provided the reference material. Controls were included of cells cultured in medium that had been incubated under conditions identical to those used with the extracts. Cell survival (3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide reduction) and proliferation (5-bromo-2'-deoxyuridine incorporation) were measured.

Results: Extracts of silver-containing dressings (Acticoat, Aquacel-Ag, Contreet-H, and Avance) were most cytotoxic. Extracts of Hydrasorb were less cytotoxic but markedly affected keratinocyte proliferation and morphology. Extracts of alginate-containing dressings (Algisite M, SeaSorb, and Contreet-H) demonstrated high calcium concentrations, markedly reduced keratinocyte proliferation, and affected keratinocyte morphology. Extracts of Aquacel and Comfeel Plus transparent induced small but significant inhibition of keratinocyte proliferation.

Conclusions: The principle of minimizing harm should be applied to the choice of wound dressing. Silver-based dressings are cytotoxic and should not be used in the absence of infection. Alginate dressings with high calcium content affect keratinocyte proliferation probably by triggering terminal differentiation of keratinocytes. Such dressings should be used with caution in cases in which keratinocyte proliferation is essential. All dressings should be tested in vitro before clinical application. (Plast. Reconstr. Surg. 117 (Suppl.): 1105, 2006.)
In Vitro Study

Diabetic Patients

Clinical Study
In Vitro Study
Purpose of the Study
(In Vitro Study)

- To examine the cytotoxicity of silver dressings on diabetic fibroblasts
Patients and Methods (I)

- **Diabetic fibroblast**
  - 4 patients (2 male and 2 female)

- **Silver-containing material (5 Types)**

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<th>Manufacturer</th>
<th>Basic dressing composition</th>
<th>Silver modality</th>
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Patients and Methods (II)

- Diabetic fibroblast cultures with dressing materials

1. Cell morphology
2. Cell proliferation
3. Collagen synthesis assay
4. Extraction test of dressings
Results (I)

Cell morphology
Results (II)

Cell proliferation
Results (III)

Collagen synthesis assay
# Results (IV)

## Extraction test of dressings

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</table>

IP, inorganic phosphate; $\text{CO}_2$, total carbon dioxide content of a sample.
Conclusion

- Silver-containing dressing materials on diabetic fibroblasts
  - Change the cell morphology
  - Decrease cell proliferation
  - Decrease collagen synthesis

Cytotoxicity of silver on diabetic fibroblasts is examined
Clinical Study
Purpose of the Study (Clinical Study)

- To evaluate the influence of silver on wound healing in diabetic patients following the previous in vitro research
Patients and Methods (I)

• 15 patients
  - Diabetic foot patients
  - Donor sites from STSG
  - Sex: 9 male, 6 female
  - Age: from 19 to 79 years (mean 54 years)
Patients and Methods (II)

- A hydrophilic polyurethane material
  (Medifoam®, Ildong, Seoul, Korea)
- A hydrophilic polyurethane material with silver
  (Medifoam silver®, Ildong, Seoul, Korea)
Results (I)

\[ p = 0.109 \]
Results (II)

1. Healed on the same day
2. Medifoam silver delayed for wound healing
Cases
Conclusion

- **Silver-containing dressing materials**
  - Delay wound healing on diabetic patients
  - No statistical significance