Resistance of *Acanthamoeba* Cysts to Disinfection in Multiple Contact Lens Solutions

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Division of Parasitic Diseases, CDC, Atlanta, GA
Isolation of *Acanthamoeba* From:

- Fresh & Frozen Antarctic Water, Brackish & Sea Water
- Swimming Pools, Hot Springs, Spa, Hot Tubs
- Power Plant Effluents
- **Toxic waste dumpsites with high levels of pesticides, herbicides, pharmaceuticals, heavy metals, PCBs**
- Dust in the air
- HVAC
- Ocean Sediments, Sewage, Soil, Compost
- Vegetables, Mushrooms
- Fish, Reptiles, Birds, Mammals
- Medicinal Pools, Dental Equipment, Gastric Washings, IUCD
- Cell Cultures, Human Nasal Sinuses, Throat, Intestines, Cornea, Skin Lesions, CNS
- Contact Lens Paraphernalia
Infections Due to *Acanthamoeba* spp.

ANY TIME OF THE YEAR

ENVIRONMENT

- Air
- Dust
- Soil
- Freshwater

Contact-lens wearing

Contaminated solutions

Acanthamoeba trophozoite

Nasal infection

Granulomatous amebic encephalitis

Acanthamoeba bone infection

Acanthamoeba dermatitis

Acanthamoeba pneumonitis

Immunocompromised host

Corneal trauma

Acanthamoeba keratitis
Acanthamoeba Keratitis

♣ Acanthamoeba keratitis (AK) is a painful, vision-threatening infection

♣ Leads to ulceration of the cornea, loss of visual acuity, and eventually blindness and enucleation
Acanthamoeba Keratitis (AK)

♣ AK occurs in immunocompetent individuals

♣ Associated with trauma to the cornea or commonly in contact lens wearers as a result of poor lens care hygiene

♣ The first case of AK in the United States occurred in 1973 in a south Texas rancher following trauma to his right eye

♣ Both trophozoites and cyst stages of Acanthamoeba polyphaga were demonstrated in corneal sections

♣ Cases have continued to increase sporadically since 1985 due to the popularity of daily wear or extended wear soft contact lenses
A recent study indicated a dramatic increase in AK cases in the Chicago, IL area during May 1, 2003 and September 15, 2006.

CDC conducted a survey of 22 ophthalmology centers in February 2007, which revealed a national increase in the number of AK cases starting in 2004 and continuing through 2007.

A subsequent investigation identified the use of Advanced Medical Optics Complete® Moisture Plus™ multipurpose contact lens solution as a primary risk factor leading to an international recall by the manufacturer (Joslin 2007; Verani – MMWR 2007).
Materials & Methods

♣ Eleven different contact lens solutions

♣ Alcon OPTI-CLEAN® II
♣ Alcon OPTI-FREE® Express
♣ Alcon OPTI-FREE® Replenish
♣ AMO Complete® Moisture Plus
♣ AMO UltraCare®
♣ B&L Boston Simplus®
♣ B&L ReNu MoistureLoc®
♣ B&L ReNu MultiPlus®
♣ CibaVision ClearCare®
♣ Ciba Vision AQuify®
♣ Kirkland Signature Multi-Purpose Solution

All purchased from retail stores in the Atlanta area
Materials & Methods

♣ Three species of *Acanthamoeba* (*A. castellanii*, *A. polyphaga*, and *A. hatchetti*) all belonging to Genotype T4 (Images A-C) were used in this study

♣ All isolated from specimens collected during a 2007 outbreak of *Acanthamoeba* keratitis
Materials & Methods

- Amebae were grown on agar plates coated with bacteria
- Morphologic and Genotypic analysis performed and the amebae were allowed to differentiate into cysts
- Cysts were suspended in ameba saline and adjusted to yield 100 cysts per 10 µl
- Ten microliters of the cyst-containing ameba saline was added to one ml of each Multipurpose CL solution (in triplicate)
- Incubated at 24°C for 4 or 6 (according to manufacturer’s recommendations) and 24 hours
Materials & Methods

- Solutions were washed by centrifugation
- Inoculated on agar plates coated with *E. coli*
- Incubated at 24°C
- Plates examined daily for 2 weeks with inverted microscope for the presence of trophozoites or tracks
- Efficacy of solutions was scored qualitatively
## RESULTS

### Efficacy of CL solutions Against *Acanthamoeba* spp.

<table>
<thead>
<tr>
<th>Contact Lens Solution</th>
<th>Active Ingredients</th>
<th><em>A. castellanii</em></th>
<th><em>A. polyphaga</em></th>
<th><em>A. hatchetti</em></th>
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<td>Plates + % + Plates + %+</td>
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<tr>
<td>Alcon OPTI-CLEAN® II</td>
<td>PolyQuad® 0.001%</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
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<tr>
<td>Alcon OPTI-Free® Express</td>
<td>Polyquad® ALDOX®</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
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<tr>
<td>Alcon OPTI-Free® Replenish</td>
<td>Propylene glycol PolyQuad® 0.001% ALDOX® 0.0005%</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
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<tr>
<td>AMO Complete® MoisturePlus</td>
<td>PHMB®0.0001 %, Poloxamer237</td>
<td>3/3 100% 3/3 100% 3/3 100% 3/3 100% 3/3 100% 3/3 100%</td>
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<tr>
<td>AMO UltraCare®</td>
<td>3% Hydrogen peroxide</td>
<td>3/3 100% 3/3 100% 3/3 100% 3/3 100% 3/3 100% 3/3 100%</td>
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<td>4-6 h</td>
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<tr>
<td>Ciba Vision Clear Care®</td>
<td>3% hydrogen peroxide</td>
<td>0/3</td>
<td>0%</td>
<td>0/3</td>
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<td>4-6 h</td>
<td>24 h</td>
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<tr>
<td>Ciba Vision Aquify®</td>
<td>Polyhexanide 0.0001%</td>
<td>3/3</td>
<td>100%</td>
<td>3/3</td>
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<td></td>
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<td>4-6 h</td>
<td>4-6 h</td>
<td>24 h</td>
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<tr>
<td>Kirkland Signature Multi-Purpose Solution®</td>
<td>Polyaminopropyl biguanide 0.0001%</td>
<td>3/3</td>
<td>100%</td>
<td>3/3</td>
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<tr>
<td><strong>B&amp;L Boston Simplus®</strong></td>
<td>Chlorhexidine gluconate 0.03% Polyaminopropyl biguanide 0.0005%</td>
<td>3/3 100% 1/3 33% 3/3 100%</td>
<td>2/3 66% 3/3 100%</td>
<td>2/3 66%</td>
</tr>
<tr>
<td><strong>B&amp;L ReNu MoistureLoc®</strong></td>
<td>Alexidine 0.00045%</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
<td>2/3 66% 3/3 100%</td>
<td>2/3 66%</td>
</tr>
<tr>
<td><strong>B&amp;L ReNu MultiPlus®</strong></td>
<td>DYMED 0.0001%</td>
<td>3/3 100% 3/3 100% 3/3 100%</td>
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Results

♣ One of the hydrogen peroxide containing solutions (Ciba Vision Clear Care) demonstrated the greatest inactivation of cysts of all 3 species of *Acanthamoeba*

♣ Of the 11 contact lens solutions, only 2 showed any activity against *A. castellanii* cysts

♣ Ciba Vision Clear Care was 100% effective in killing cysts at both 6 and 24 hours (0/6 plates positive)

♣ B&L Boston Simplus® had no activity at 4 hours but was 66% effective at 24 hours (1/3 plates positive)
Results

♣ 4 other solutions demonstrated no activity in preventing excystation after 4 hours of contact but some activity after 24 hours

♣ B&L Boston Simplus® and B&L ReNu MoistureLoc® were 33% effective at killing cysts of *A. polyphaga* (2/3 plates positive)

♣ Ciba Vision Aquify and Kirkland Signature MPS were 66% effective at killing cysts of *A. polyphaga* (1/3 plates positive)
None of the 11 solutions tested demonstrated 100% killing of *A. hatchetti* cysts after 4-6 hours.

- Only **Ciba Vision Clear Care** was 33% effective after 6 hours and **100% effective after 24 hours** contact.

- **B&L Boston Simplus® and B&L ReNu MoistureLoc®** were 33% effective (2/3 plates positive) after 24 hours of contact.
Conclusions

♠ Of the 11 multipurpose solutions tested

♠ Ciba Vision Clear Care containing 3 % hydrogen peroxide was 100% effective against cysts of *A. castellanii* and *A. polyphaga* at both 6 and 24 hours of contact.

♠ With cysts of *A. hatchetti*, however, this solution was 100% effective after 24 hours but only 33% effective after 6 hours of contact.
Conclusions

♣ Solutions without hydrogen peroxide had varying degrees of activity against cysts of all 3 species of *Acanthamoeba*, but none had activity at 4 hours of contact.

♣ However, some solutions had activity after 24 hours of contact.

♣ Most contact lens wearers do not soak lenses longer than 8-12 hours (overnight).

THANK YOU