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New York State Continuing Education Mail-In Course

Soft Contact Lens Care Products

By Michael A. Ward, MSc, FAAO

The contact lens care industry has evolved from systems-based products of the early 1970s to today's all-in-one-bottle lens care. Today's products are convenient, effective and safe, and largely without the toxicity and hypersensitivity adverse effects that resulted from early generation chemical disinfectants. However, not all contemporary soft contact lens care products are alike.

Daily Cleaners

Surfactants are a class of chemicals that possess hydrophobic and hydrophilic components within the same molecule which enables them to quickly attach and solubilize different types of debris. Daily cleaners usually contain a combination of surfactants plus preservatives.

Noteworthy soft lens daily cleaners that are still available include Alcon's Opti-Free Daily Cleaner and CIBA Vision's Miraflow Extra-Strength Cleaner. Opti-Free Daily Cleaner is an abrasive cleaner that uses small polymeric beads to enhance the mechanical stripping of proteins and debris from lens surfaces. Miraflow contains 15.7% isopropyl alcohol, which acts as a lipolytic solvent that helps remove oils and makeup from lens surfaces and provides an effective antimicrobial punch. Contact lens cleaners seldom cause ocular reactions if lenses are properly rinsed.

Separate daily cleaners have decreased in use since the advent of multipurpose solutions (MPS). Daily cleaners feature a red top under the cap to signal to patients that the product does not go directly into the eye.

Salines

Saline solutions do not disinfect lenses. They rinse daily cleaners from lenses and are used in conjunction with some hydrogen peroxide, ultraviolet and, rarely, heat disinfection systems. They are available in preserved and unpreserved forms.

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Most preserved salines contain potassium sorbate (sorbic acid), which is a relatively weak, static inhibitor of microbial growth. SoftWear Saline (CIBA) uses low-level hydrogen peroxide as a preservative, in which the concentration of H₂O₂ at 60 parts per million (ppm) falls below ocular sensitivity levels. Both work well for their intended purposes and have a low incidence of adverse reactions. Sorbate-preserved salines may discolor some soft lenses, particularly when used with heat or exposed to ultraviolet light.

Unpreserved salines are available in aerosol cans (Advanced Medical Optics' [AMO's] Lens Plus and Bausch & Lomb's Sensitive Eyes Sterile Saline Spray) and in multi-dose, 4-oz squeeze bottles (Unisol-4 [Alcon] and PuriLens Solution [The LifeStyle Company]). Aerosol spray salines offer the safest form of preservative-free, multi-dose saline because microbes cannot enter the nitrogen gas-pressurized containers.

Wearer compliance with multi-dose squeeze bottles may be an issue. These products are also prone to microbial contamination once the bottle is open. Patients should never use saline from a non-preserved, multi-dose squeeze bottle as an eye drop or to rinse lenses before placing them in the eye.

Multipurpose Solutions (MPS)

Lens care products have evolved from multi-step, single-purpose products to simplified multipurpose products. Manufacturers added cleaners (detergents) to the disinfecting/storage solutions to reduce care

systems' procedures by one step. Similarly, adding protein removers eliminated another step.

None of the MPS solutions contain proteolytic enzymes. Chelating and sequestering agents chemically bind proteins and metals to prevent their attachment to the lens surfaces. Once one manufacturer claimed that its products contained protein removers, other manufacturers reformulated their respective products so they could make similar claims. The same competitive scenario has recently played out regarding the "no-rub" moniker, which has further simplified MPS usage.

The four most popular no-rub MPS products available in the United States are Complete Moisture Plus (AMO), Opti-Free Express (Alcon), ReNu MultiPlus (B&L) and SOLO-care Plus (CIBA). Table 1 shows the preservatives and disinfectants that these products contain.

MPS products that contain biguanide disinfectants differ by viscosity, cleaning performance, biocompatibility, wetting properties, buffers, lubricants and surfactants. I describe the most common MPS products below. All MPS solutions noted are approved for use with all soft contact lenses.

AMO's *Complete Moisture Plus MPS* is a new formulation, designed to promote ocular health as well as thorough lens care. It now contains two ophthalmic demulcents (lubricants): propylene glycol and hydroxypropyl methylcellulose (HPMC). In addition, the manufacturer has added electrolytes and the amino acid taurine for their beneficial physiologic effects. AMO has reduced the concentration of ethylenediamine tetra acetate (EDTA) from 0.02% to 0.01%. The required soak time for antimicrobial effectiveness is reduced from six hours to four hours, and the second rinse has been eliminated.

ReNu MultiPlus Multi-purpose Solution is a borate-buffered MPS that contains the cleaning agent Tetronic 1107 (poloxamine) and the sequestering agent/protein remover Hydranate (hydroxyalkylphosphonate). It meets FDA stand-alone criteria as a disinfecting solution and requires a four-hour soak time. The manufacturer claims that ReNu's intense cleaning and protein removal promote patient comfort. The current ReNu formula has been on the market since 1997.

CIBA Vision reformulated its *SOLO-care Plus MPS* in 2002. CIBA replaced the phosphate buffer with bis-tris propane (BTP), which also increases the antimicrobial effectiveness of PHMB. The surfactant qualities of Aqualube (cremophor RH 40) minimize protein deposition to lenses and help retain moisture. SOLO-care is the least viscous of the MPS solutions. The reformulated solution is no longer approved for use

TABLE 1 Multipurpose Solution Preservatives and Disinfectants

QUATERNARY AMMONIUM COMPOUND

Polyquaternium-1 (Polyquad) is Alcon's proprietary antimicrobial. Alcon uses it in many of its products, including Opti-Free Express, in which the concentration is 10 part per million (ppm). Quaternary ammonium compounds reduce the surface tension at interfaces and denature proteins of the microbial cell walls, causing microbial cell death. Polyquad is a later generation "quat" that demonstrates heightened antimicrobial activity and attenuated toxicity.

AMIDOAMINE

Myristamidopropyl dimethylamine (Aldox) is a cationic amidoamine also known as stearamidopropyl dimethylamine. Aldox is Alcon's proprietary antifungal/antiamoebic, used at a concentration of 5ppm in conjunction with Polyquad in Opti-Free Express.

BIGUANIDES

Polyhexamethylene biguanide HCl (PHMB), also known as polyaminopropyl biguanide (Dymed) and polyhexanide, is an excellent broad-spectrum cationic antimicrobial agent. It electrostatically binds and subsequently destroys the cytoplasmic membranes of microbes, which disrupts metabolic activity and results in irreversible loss of intracellular components. Complete Moisture Plus (AMO), ReNu MultiPlus (B&L) and SOLO-care Plus (CIBA) contain biguanides at a concentration of 1ppm.

CHELATING AGENT

Ethylenediamine tetra acetate (EDTA) is a chelating agent that binds free metals (magnesium and calcium) and enhances antimicrobial activity of disinfectants. All of the MPS products contain this agent.

with gas permeable lenses. SOLO-care has the only dual approval for both a five-minute rub-and-rinse disinfection cycle and a six-hour, no-rub soak. This FDA approval argues in favor of the benefits of digital rubbing.

Alcon's *Opti-Free Express Lasting Comfort Formula* is a multipurpose disinfecting solution that contains Polyquad as a preservative and Aldox as a disinfectant. Citrate attracts protein, and Amp-95, an amino alcohol with dispersant qualities, assists in cleaning. The surfactant Tetronic 1304 emulsifies lipids for cleaning and serves as a wetting agent. Last year the FDA approved new comfort claims for Opti-Free Express's package labeling, including "Lasting Comfort Formula" and "for any contact lens including silicone hydrogel." Disinfection requires a six-hour soak time. Alcon last reformulated Opti-Free Express in 1999.

Generic MPS products that are available through private label and mass merchandisers represent a large portion of the market. The problem with using generic care products is that neither the practitioner nor the patient knows what solution the patient is actually using. Mass merchandisers commonly purchase previous generations of national brand MPS solutions and label them under the store brand. It is a highly competitive market. The stores bid from manufacturers approximately every six months. Therefore, Wal-Mart's Equate brand in October may not contain the same solution ingredients as it did in January of the same year. This makes the practitioner's detective work a little more challenging in the event of a solution reaction.

Hydrogen Peroxide Disinfectants

Hydrogen peroxide systems offer a comfort level to lens care not available with MPS solutions. The active ingredient in peroxide-based systems is microfiltered, stabilized and buffered 3% hydrogen peroxide. It eliminates a wide variety of organisms: bacteria, yeasts, fungi, spores and viruses. As a strong antioxidant, it kills microbes by damaging cell membranes and creating transient and toxic free ion superoxide and hydroxyl radicals.

Unlike most disinfecting agents, hydrogen peroxide is unaffected by organic matter or salts. Peroxides can penetrate microbial biofilms, which preservative-based MPS products cannot. Approximately 10 minutes at full strength exposure will eliminate most bacteria. Fungi and protozoa require longer exposure times.

The hydrogen peroxide in these systems must be neutralized to oxygen and water before the patient wears the lenses. Catalase enzyme and catalytic disc are two methods of peroxide neutralization available in the United States.

UltraCare (AMO) is a one-step peroxide system that uses the enzyme catalase to neutralize hydrogen peroxide. In this system, patients add a catalase neutralizing tablet to the lens case at the same time as the peroxide disinfectant solution. The catalase-based neutralizing tablet is encapsulated in hydroxypropyl methylcellulose (HPMC), which time-delays the neutralizer to allow a controlled exposure time for the disinfectant. HPMC also acts as a lubricant dissolved in the storage solution. Cyanocobalamin (Vitamin B₁₂) creates a pink hue to indicate that the neutralizing tablet has been added to the system.

AOSept, Pure Eyes and Clear Care (formerly AOSept Clear Care) [CIBA] all use a platinum-coated plastic disc to catalyze the breakdown of the hydrogen peroxide into oxygen and water. The age of the disc determines whether neutralization occurs in a few minutes or in several hours. A fresh disc neutralizes

the peroxide quickly, thus providing less antimicrobial activity but a more thorough neutralization. An old disc provides longer contact time with higher concentrations of peroxide, but with less effective neutralization. AOSept and Pure Eyes use a saline rinse following neutralization. The newest member of this family, Clear Care, is a one-step product that carries the no-rub indication. The solution contains surfactants and does not use a final saline rinse. Instruct patients not to rinse their lenses with this solution following the disinfection cycle because a toxic reaction may result. Patients may safely add aerosol saline to the system if they desire a final rinse after disinfection.

Although hydrogen peroxide systems have high antimicrobial efficacy, once neutralized they become unpreserved, aqueous bathing solutions capable of supporting microbial growth. Non-preserved peroxide systems work fine if used on a daily basis. However, if lenses have been soaking in the neutralized solution for more than one day, patients should repeat the disinfecting/neutralizing procedure prior to lens wear. They should also pay attention to the inside of the lens case cap. Inverting the lens case or shaking the case with fresh, un-neutralized peroxide can disinfect the inside cap. Patients should follow the instructions of the individual systems.

Ultraviolet Light Disinfection

The PuriLens (The LifeStyle Company) contact lens care system offers an electronic, preservative-free option to hydrogel lens care. The PuriLens system uses subsonic vibration along with short-wavelength ultraviolet (UV) radiation to clean and disinfect soft contact lenses. The system uses its own brand of non-preserved, multi-dose, squeeze-bottle saline.

A 60-cycle-per-minute oscillating pedal creates waves of vibration inside the lens disinfection case to clean the lenses. A lamp that produces white light and heat as well as UV-C at 253.7nm for a 15-minute cycle disinfects the lenses. UV radiation kills microbes by breaking nucleic acid bonds in their DNA. A lens holder/cage fits inside the case and shields the lenses from direct UV radiation. The lenses, certain areas of the case and the lens holder are not subjected to the radiation.

As with any product, improper use may cause potential complications. Instruct your patients to remove the lid of the lens case before initiating the disinfection cycle. Failure to remove the case lid will prevent proper disinfection. Unfortunately, the unit will appear to operate normally, even when the case lid is in place.

Practitioners should be aware that with normal operation there is no disinfection of certain areas of the case, including inside the case lid. The system

may become contaminated if microbes are present on the inside of the case lid when it is replaced following disinfection. As mentioned previously, patient compliance with non-preserved, multi-dose, squeeze-bottle saline may warrant further concern.

Enzymatic Cleaners

Proteolytic enzymes remove accumulations of tear proteins from lens surfaces. The enzymes work by catalyzing and lysing specific bonds in the amino acid chains of proteins. Historically they served as a separate, weekly cleaning step to control protein, primarily lysozyme, buildup on conventional lenses. Enzyme use has declined in recent years because of more frequent lens replacement schedules and protein-inhibiting additives in MPS products. Enzyme use today is relegated to lenses worn for one month or longer.

Three generic types of proteolytic enzymes are currently used with contact lenses: papain (from papaya), pancreatin (from pork) and subtilisin (from *bacillus sp.* bacteria). Papain is the active ingredient in Allergan's Enzymatic Contact Lens Cleaner. Opti-Free and Optizyme (Alcon) enzymatic cleaners use porcine pancreatin. Complete Weekly Enzymatic Cleaner (AMO), Ultrazyme (Allergan), ReNu 1-Step, Effervescent and Sensitive Eyes Enzymatic Cleaners

(B&L) and Unizyme (CIBA) use subtilisin. Supra-Cleans (Alcon) is a convenient, liquid form of pancreatin enzyme that patients can add daily to the storage solution for both soft and rigid lenses. Patients should rinse lenses free of enzyme cleaners before lens wear.

In-eye Cleaners and Rewetting Agents

Two products are now available to reduce protein buildup, rewet and clean lenses during wear. Complete Blink-N-Clean Lens Drops (AMO) is a PHMB-preserved solution that uses tromethamine as the emulsifier/buffer, HPMC as the lubricant, tyloxapol as a surfactant and EDTA as a chelating agent. The recommended dosage is one to two drops up to four times a day.

Clerz Plus Lens Drops (Alcon) is a Polyquad-preserved solution that uses Tetronic 1304 as its surfactant/wetting agent and RLM-100 (lauryl ether carboxylic acid) as its surfactant. The directions recommend using two drops as needed during the day for minor irritations and using two drops four times each day to prevent protein buildup.

"This information originally appeared in "Soft Contact Lens Care Products" from the July 2003 Contact Lens Spectrum and is used with permission."

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Soft Contact Lens Care Products

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- Which of the following is NOT an example of a daily cleaner, according to the article?
 - CIBA Vision's Miraflo
 - Alcon's Patanol
 - Alcon's Opti-Free
 - All of the above are examples of daily cleaners.
- Daily lens cleaner containers feature a red top under the cap:
 - to signal to patients that the product may stain skin and clothing.
 - to signal to patients that the product is flammable.
 - to signal to patients that the product does not go directly into the eye.
 - to signal to patients that the product should be used only in red or irritated eyes.
- Saline solutions are indicated for disinfecting and storing spare lenses.
 - True
 - False
- Which of the following is NOT an example of a multipurpose solution?
 - Alcon's Opti-Free Express
 - B&L's ReNu MultiPlus
 - CIBA's SOLO-care Plus
 - All of the above are examples of multipurpose solutions.
- Alcon's Optifree and B&L's ReNu contain proteolytic enzymes.
 - True
 - False
- All of the following are soft lens multi-purpose solution preservatives EXCEPT:
 - Polyquaternium-1
 - Polyaminopropylbiguanide
 - Ethylenediamine tetra acetate
 - Hydrogen peroxide
- Each MPS product approved for use with all soft contact lenses is also approved for use with late-generation silicone hydrogel lenses.
 - True
 - False
- Hydroxypropyl methylcellulose (HPMC) is a:
 - preservative
 - lubricant
 - disinfectant
 - viscoelastic
- Peroxides can penetrate established microbial biofilms, where MPS products cannot.
 - True
 - False
- All of the following statements are true EXCEPT:
 - AMO's Ultracare uses cyanocobalamin as the disinfectant.
 - Clerz Plus Lens Drops are indicated to prevent protein buildup by instilling two drops four times a day.
 - Optifree and Optizyme enzymes use porcine pancreatin as the active ingredient.
 - The Purilens system does not disinfect certain areas of the lens case, including inside the case lid.
- Based on Ciba Vision's SoloCare MPS, digital rubbing of a lens with MPS product can significantly decrease the required time necessary for lens disinfection.
 - True
 - False
- Which of the following is NOT an example of a proteolytic enzyme used for lens cleaning?
 - Pancreatin derived from the porcine pancreas
 - Catalasin derived from liver
 - Papain derived from the papaya plant
 - Subtilisin derived from bacteria
- Which delivery method of preservative-free, multi-dose saline solutions provides the best protection against microbial contamination?
 - Squeeze bottle
 - Brush applicator
 - Pump spray
 - Aerosol spray
- Which of the following microbe types requires the least amount of time to kill using a hydrogen peroxide-based lens disinfectant?
 - Fungi
 - Bacteria
 - Protozoa
 - Phylumoa
- Unlike most disinfecting agents, hydrogen peroxide is unaffected by organic matter or salts.
 - True
 - False

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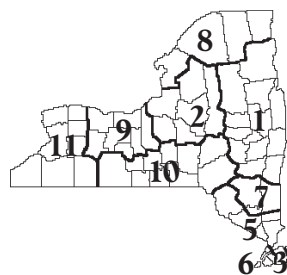
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