Research studies in solutions

Recent studies have again focused on contact lens care products and their effects on ocular tissue

While the contact lens industry awaits the next major leap forward in lens design and technology, researchers continue to examine aspects of lens care solutions and their compatibility with the eye. Two papers by Cavanagh and co-authors published early this year shed more light on the effects of solutions on the cornea.

In January's *Investigative Ophthalmology and Vision Science*, Robertson *et al*[1] report on a study into the effects of non-preserved solutions on the corneal epithelium in long-term daily wear of silicone hydrogel lenses when compared with extended wear with these lenses. A total of 121 subjects completed the 13-month study wearing one of three SiH lenses for either daily or extended wear.

Daily wear had no significant effect on central epithelial thickness and a decrease in thickness in extended wear recovered (adapted) over one year. Both modalities decreased epithelial surface cell exfoliation rate (desquamation) with adaptive effects over one year. There was no significant difference in binding of *Pseudomonas aeruginosa* (*PA*) to exfoliated corneal surface cells between lenses or between modality of wear.

The authors say that *PA* binding to epithelial cells is a prerequisite to infection, and no binding indicates no lens-enhanced risk of infection. They conclude that, in contrast to previous studies with preserved lens care products, the absence of change in *PA* binding in this study predicts the risk of keratitis should be similar for daily and extended SiH wear over one year when preservative-free solutions are used.

The second study,[2] by researchers at Menicon in Japan and Cavanagh, is published in the January issue of *Eye & Contact Lens*. It compares the effects of four multipurpose solutions (MPS) on the structure and barrier function of corneal epithelial tight junctions. Human corneal epithelial cells were cultured on collagen-coated slides and then exposed to one of four MPS for 60 minutes. Cells were then evaluated with confocal microscopy and transmission electron microscopy, and barrier function was assessed by measuring their electrical resistance.

Frequent use of an MPS with high cytotoxity may affect epithelial barrier function

Control cells without MPS treatment and those treated with one of two PHMB-preserved solutions showed normal cell junctions and no difference in electrical resistance, but cells treated with the three other MPS showed disrupted structures and a time-dependent decrease in resistance.

The authors say their results suggest the possibility that frequent use of an MPS with high cytotoxicity may lead to the breakdown of epithelial barrier function and increase the risk of associated microbial infections in soft lens wearers.

Physical properties

Physical properties of contact lens solutions are rarely investigated but one recent study found that certain properties vary significantly. Researchers at The University of Waterloo, Canada examined various properties of 10 MPS and non-preserved solutions and report their results in the February issue of *Optometry and Vision Science*.[3]

The pH of most solutions was close to neutral, except for two neutralised peroxide systems and a polyquad-preserved solution which also had a lower osmolality. Surface tension measurements fell into low, medium and high values with significant differences between the three groupings. Viscosity was similar for all products except one PHMB-preserved solution. Un-neutralised peroxide solutions had very different pH and osmolality values from all the solutions that would directly contact the eye.

Incorporating lubricating agents in daily disposables might be expected to influence patient comfort but a study in March's *Eye & Contact Lens* suggests optical quality may also be affected.

Koh and co-workers[4] recruited 15 disposable lens wearers with dryness-related symptoms and 15 non-contact lens wearers. Ocular higher order aberrations (HOAs) were measured for 60 seconds in each subject wearing an etafilcon A lens and an etafilcon A lens with polyvinyl pyrollidone (PVP) after an hour of wear. During the measurement, subjects were forced to blink every 10 seconds.

In symptomatic wearers, total HOAs, fluctuation and stability were all lower with the lens with PVP than with the conventional lens, whereas a significant difference between the two lenses was observed only for fluctuation in non-wearers. Subjective ocular dryness with the PVP lens decreased compared with the conventional lens in both groups.

Finally, the latest salvo in the solution-related staining war was fired by Bausch & Lomb with the launch in February of a new website on the science behind corneal staining and new methods of grading and evaluation. The site, www.truthaboutstaininggrid.com, provides downloads of many of the recent publications in this area.

● To access the abstracts and full text of these papers go to the journal website or enter www.ncbi.nih.gov/entrez/ and search by author name.

References

1 Robertson DM, Petroll WM and Cavanagh HD. The effect of non-preserved care solutions on 12 months of daily and extended wear silicone hydrogel contact lens wear. *Invest Ophthalmol Vis Sci*, 2008;49:1 7-15.

2 Imayasu M, Shiraishi A, Ohashi Y *et al.* Effects of multipurpose solutions on corneal epithelial tight junctions. *Eye & Contact Lens*, 2008;34:1 50-55.

3 Dalton K, Subbaraman LN, Rogers R *et al.* Physical properties of soft contact lens solutions. *Optom Vis Sci*, 2008;85:2 122-8.

4 Koh S, Maeda N, Hamano T *et al.* Effect of internal lubricating agents of disposable soft contact lenses on higher order aberrations after blinking. *Eye & Contact Lens*, 2008;34:2 100-105.