Novel contact lenses provide extended pain relief to laser eye surgery patients

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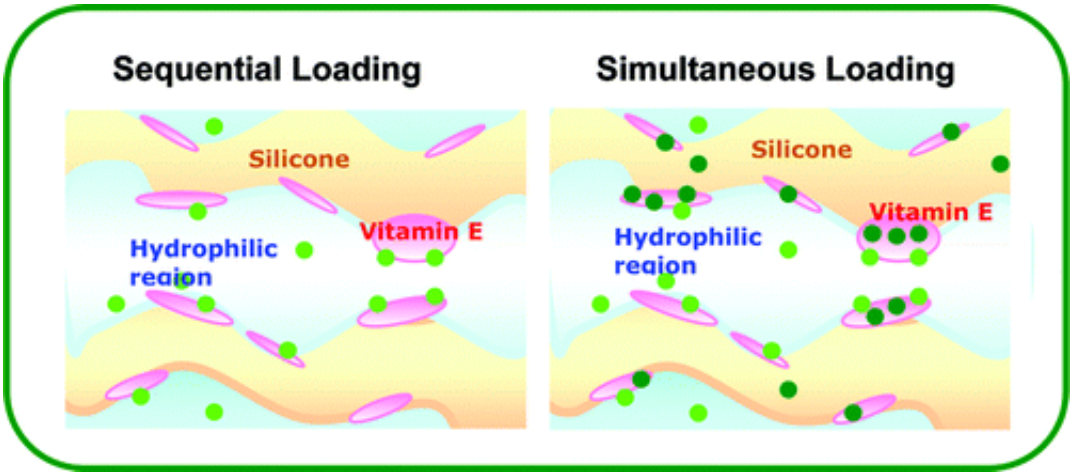

Scientists are reporting development of contact lenses that could provide a continuous supply of anesthetic medication to the eyes of patients who undergo laser eye surgery — an advance that could relieve patients of the burden of repeatedly placing drops of medicine into their eyes every few hours for several days. Their report appears in ACS' journal *Langmuir*.

Anuj Chauhan and colleagues explain that more than 1 million laser eye correction procedures are performed each year in the U.S. The surgery enables most patients to see clearly without eye glasses or contact lenses. The procedure known as LASIK is the most common type of laser eye surgery, but complications can develop if the patient undergoes trauma

or is hit very hard at any time after the procedure. Photorefractive keratectomy (PRK) doesn't have this complication, and that's why it is preferred for athletes and those in the military. A downside to PRK, however, is a longer period of pain after surgery. To ease their pain, PRK patients place drops of several medications, including anesthetics, into their eyes every few hours, which can interfere with daily life and increase the risk of drug overdose. PRK patients receive a special "bandage contact lens" after surgery to help the outer layer of the eye heal.

The researchers tested whether anesthetics loaded onto this type of lens could release the drugs over time automatically. They found that adding vitamin E to the lenses extended the time of release of three commonly used anesthetics from just under two hours to up to an entire day — or a few days in some instances. The vitamin E acts as a barrier, keeping the anesthetics on the eye, right where they are needed. The researchers say that, in the future, these lenses could serve as bandage contact lenses after PRK surgery while also delivering necessary pain medications.

More information: Transport of Topical Anesthetics in Vitamin E Loaded Silicone Hydrogel Contact Lenses, *Langmuir*, 2012, 28 (2), pp 1478–1487. DOI: 10.1021/la203606z

Abstract
Transport of surface active anesthetic drugs through silicone hydrogel contact lenses containing nanosized vitamin E aggregates is explored for achieving extended anesthetics delivery. Commercial silicone hydrogel contact lenses release most ophthalmic drugs including local anesthetics for only a few hours, which is not adequate. Here we focus on creating dispersion of highly hydrophobic vitamin E aggregates in the lenses as barriers for drug diffusion for increasing the release durations. This approach has been shown previously to be successful in extending the release durations for some common hydrophilic ophthalmic drugs. The

topical anesthetic drugs considered here (lidocaine, bupivacaine, and tetracaine) are hydrophilic at physiologic pH due to the charge, and so these cannot partition into the vitamin E barriers. However, these surface active drug molecules adsorb on the surface of the vitamin E barriers and diffuse along the surface, leading to only a small decrease in the effective diffusivity compared to non-surface-active hydrophilic drugs. The drug adsorption can be described by the Langmuir isotherm, and measurements of surface coverage of the drugs on the vitamin E provide an estimate of the available surface area of vitamin E, which can then be utilized to estimate the size of the aggregates. A diffusion controlled transport model that includes surface diffusion along the vitamin E aggregates and diffusion in the gel fit the transport data well. In conclusion, the vitamin E loaded silicone contact lens can provide continuous anesthetics release for about 1–7 days, depending on the method of drug loading in the lenses, and thus could be very useful for postoperative pain control after corneal surgery such as the photorefractive keratectomy (PRK) procedure for vision correction.

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