Researchers develop artificial lens based glaucoma sensor

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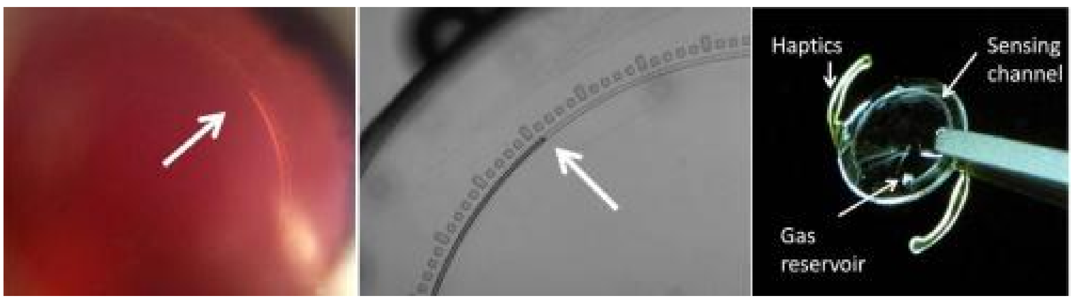

(right) Microfluidic intraocular pressure (IOP) sensor is embedded within an intraocular lens, which is routinely used during cataract surgery. A microfluidic channel is connected in one side to the eye fluid (aqueous) and to a micrometer volume size gas reservoir at the other side. Lens arms (haptics) are used for stabilizing the lens in place within the eye. Intraocular fluid (aqueous) enters the sensor channel and fills it until equilibrium between IOP and the air inside channels is achieved. (middle) The gas/liquid interface (arrow) is captured by a camera or a Smartphone equipped with optical and illumination adaptor. Scales on the outer side of the channel enhance measurements of interface position. (left) The air fluid interface (arrow) can also be easily seen by an iPhone equipped with an optical adaptor. Credit: Mandel et al.

(Medical Xpress)—A team of researchers working at Stanford University has developed a glaucoma sensor that fits onto an artificial lens. The sensor works in conjunction with a smartphone peripheral and app, and allows the person to whom it has been affixed, to measure fluid pressure insider their eyeball—a way of testing for blindness causing glaucoma. The team has published details of their sensor in the journal *Nature Medicine*.

Glaucoma is second only to cataracts as a cause of blindness in people the world over. It's a condition where the body produces too much fluid inside the eyeball, causing pressure to build. That buildup of pressure damages the optic nerve, leading to permanent blindness. There are currently many therapies for glaucoma (that work to varying degrees) and several types of devices that have been developed to diagnose the condition, but all of them have the limitation of requiring the patient to visit a doctor's office—that's problematic because fluid pressure inside the eyeball varies, thus it's nearly impossible for a doctor to know how much variation is occurring. In this new effort, the researchers have built a tiny structure onto an artificial lens that serves as a constant barometer, allowing a patient to measure their own eye pressure whenever they choose.

The sensor consists of a tube that encircles the lens, one end is embedded in the interior of the eye, the other holds a gas reservoir. Once in place, natural pressure forces eyeball fluid to be pushed through the tube (microchannel) towards the gas, the closer it gets to the gas end, the higher the fluid pressure. The device that attaches to the smartphone is a type of smartcamera—when placed over the eye, a picture is taken capturing the degree to which the eye fluid has progressed and passes that bit of information to the smartphone app, which converts it to a number that can be used by both the patient and his or her doctor. In this way, a patient can take their eye pressure similar to the ways those with hypertension can take their blood pressure, keeping records over time to create a history that can help diagnose glaucoma and treat it if the condition is found to exist.

There's one huge caveat with the sensor, of course, and that is, it's only useful for those having an artificial lens implanted (generally due to cataract repair surgery) thus it would only be helpful for a very limited number of people. If the sensor proves successful, however, it could lead to the development of a similar sensor that could be implanted in an otherwise healthy eye, in front of the iris, the team notes.

More information: An implantable microfluidic device for self-monitoring of intraocular pressure, *Nature Medicine* (2014) DOI: 10.1038/nm.3621

Abstract

Glaucoma is the second most common cause of blindness in the world. It is a multifactorial disease with several risk factors, of which intraocular pressure (IOP) is a primary contributing factor. IOP measurements are used for glaucoma diagnosis and patient monitoring. IOP has wide diurnal fluctuation and is dependent on body posture, so the occasional measurements done by the eye care expert in the clinic can be misleading. Here we show that microfluidic principles can be used to develop an implantable sensor that has a limit of detection of 1 mm Hg, high sensitivity and excellent reproducibility. This device has a simple optical interface that enables IOP to be read with a smartphone camera. This sensor, with its ease of fabrication and simple design, as well as its allowance for IOP home monitoring, offers a promising approach for better care of patients with glaucoma.