A 'micro-tap' for treating glaucoma

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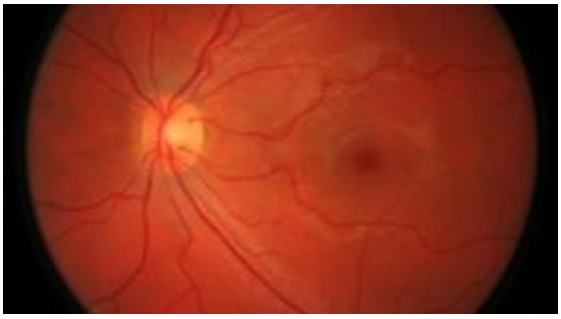

A tiny, EPFL-designed implantable device that can be positioned within the eye and controlled remotely may well revolutionize the treatment of glaucoma. The device should be through testing this year and on its way to the market in 2014 via Rheon Medical, an EPFL spin-off.

Glaucoma is the second leading cause of blindness globally, after cataracts. It is characterized by the presence of too much liquidbetween the cornea and the iris. This leads to a build-up of pressure within the eye, a situation that can destroy the optic nerve if it is not handled correctly.

Professor Nikos Stergiopulos's team at the EPFL's Laboratory of Hemodynamics and Cardiovascular Technology (LHTC) has developed an adjustable implantable "micro-tap" that can drain surplus fluid in the eye. Clinical trials on this glaucoma drainage device should be starting

before the end of the year and will be coordinated by Rheon Medical, an EPFL start-up. In addition to Prof. Stergiopulos, the project team is composed of LHTC members Stéphane Bigler, Adan Villamarin and Sylvain Roy.

The problems with current technology

In a healthy human eye, a fluid known as the "aqueous humor" is continuously being produced at the ciliary body level in the anterior chamber which is situated between the iris and the cornea. The aqueous humor is then naturally drained out through fibrous tissue called the trabecular meshwork, which functions as a filter. In people with glaucoma, the filter becomes more resistant. The aqueous humor therefore can no longer drain as it should, and intraocular pressure increases. "Glaucoma patients are at risk of losing peripheral vision initially, and ultimately of becoming completely blind," says Professor Stergiopulos.

There are several different approaches to lowering intraocular pressure. 90% of the time medicated eye drops are enough. For more serious cases, however, a tiny drain must be implanted in the affected eye through surgery to allow the liquid to flow out. However, there is a problem with the current drains: their diameter can't be adjusted. This means that sometimes the patient's intraocular pressure will shift from too high (ocular hypertony) to too low (ocular hypotony), which leads to post-operative complications. Often, a second operation is required.

Magnetic disk and silicon tube

Nikos Stergiopoulos and his team conceived of an entirely new type of mechanism to solve the pressure variation problems. The device contains a magnetic disk surrounded by a silicon tube that is designed to rotate around an eccentric axis. When the disk rotates it compresses the tube,

to a greater or lesser extent. In this way the flow rate through the tube can be adjusted. "There was no way of fitting electronics and motor-based devices into the space we had," says Professor Stergiopulos, "so we invented a ½-millimeter thick device that functions like a tiny faucet."

A simple "pen-tool" for pressure adjustments

The prototype is called the Glafkos, which is the name of a river in Greece. It can be adjusted remotely with a small tool that is about the size of a pen with an embedded compass. To "read" the implant position and change the flow rate all one needs to do is to bring the "pen-tool" near to the implant and move it around. This makes the disk spin, changing the flow rate. "Adjustments take only a few seconds. Clinicians are thus able to calibrate the implant and measure changes in pressure in real time and non-invasively, "says the scientist.

Glaucoma: An increasingly common medical condition

If it works, the new technology could eliminate post-operative complications. But that is only part of the potential payoff for glaucoma patients: "Since the device is smaller than current models, it might be possible to avoid cornea transplants in some patients who currently require them because their implants are larger," says Dr. André Mermoud, head of the Glaucoma Center at the Montchoisi Clinic in Lausanne.

For the moment, the device has been successfully tested only on rabbits. The next step is human clinical trials. The CHUV -Centre hospitalier universitaire vaudoisand- ethics Committee and SwissMedic should green-light this testing before the end of the year.

Glaucoma currently affects 1-2% of people in Switzerland, mostly older people. This prevalence rate could well rise in the coming years as the population ages. "In addition," says Dr. Mermoud, "on a world-wide scale there are a great number of people who could benefit from this new technology."

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