Measuring blood sugar with light

October 25 2013

One of the keys to healthful living with Type 1 and Type 2 diabetes is monitoring blood glucose (sugar) levels to ensure they remain at stable levels. People can easily and reliably do this at home using electronic devices that read sugar levels in a tiny drop of blood.

Now a team of German researchers has devised a novel, non-invasive way to make monitoring easier. Using infrared laser light applied on top of the skin, they measure sugar levels in the fluid in and under skin cells to read blood sugar levels. They describe their method in the current edition of *Review of Scientific Instruments*, which is produced by AIP Publishing.

"This opens the fantastic possibility that diabetes patients might be able to measure their glucose level without pricking and without test strips," said lead researcher, Werner Mäntele, Ph.D. of Frankfurt's Institut für Biophysik, Johann Wolfgang Goethe-Universität.

"Our goal is to devise an easier, more reliable and in the long-run, cheaper way to monitor blood glucose," he added.

The "Sweet Melody" of Glucose

Their new optical approach uses photoacoustic spectroscopy (PAS) to measure glucose by its mid-infrared absorption of light. A painless pulse of laser light applied externally to the skin is absorbed by glucose molecules and creates a measurable sound signature that Dr. Mäntele's team refers to as "the sweet melody of glucose." This signal enables

researchers to detect glucose in skin fluids in seconds.

The data showing the skin cell glucose levels at one-hundredth of a millimeter beneath the skin is related to blood glucose levels, Mäntele said, but previous attempts to use PAS in this manner have been hampered by distortion related to changes of air pressure, temperature and humidity caused by the contact with living skin.

To overcome these constraints, the team devised a design innovation of an open, windowless cell architecture. While it is still experimental and would have to be tested and approved by regulatory agencies before becoming commercially available, the team continues to refine it.

In a close collaboration with an industry partner (Elte Sensoric: http://www.elte-sensoric-gmbh.de/), they expect to have a small shoebox-sized device ready in three years, followed by a portable glucometer some years later.

More information: The article, "Windowless ultrasound photoacoustic cell for in vivo mid-IR spectroscopy of human epidermis: Low interference by changes of air pressure, temperature, and humidity caused by skin contact opens the possibility for a non-invasive monitoring of glucose in the interstitial fluid," is authored by Miguel A. Pleitez, Tobias Lieblein, Alexander Bauer, Otto Hertzberg, Hermann von Lilienfeld-Toal, and Werner Mäntele. It appears in the journal *Review of Scientific Instruments*. dx.doi.org/10.1063/1.4816723

Provided by American Institute of Physics

Citation: Measuring blood sugar with light (2013, October 25) retrieved 25 April 2024 from https://phys.org/news/2013-10-blood-sugar.html

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