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Laser-implant contact lens could be glucose monitor

Before the 1980s are over, diabetic patients may be wearing a contact lens that keeps track of blood glucose levels and perhaps monitors other metabolites as well.

That hope is offered by Oklahoma City researchers whose initial studies indicate that optical rotation by the aqueous humor can be measured noninvasively quickly and accurately enough to determine what has happened in the body only a few seconds before.

Optical rotation by the aqueous humor reflects the glucose concentration in that fluid. In turn, the glucose concentration in aqueous humor is known to vary proportionately with levels in the blood.

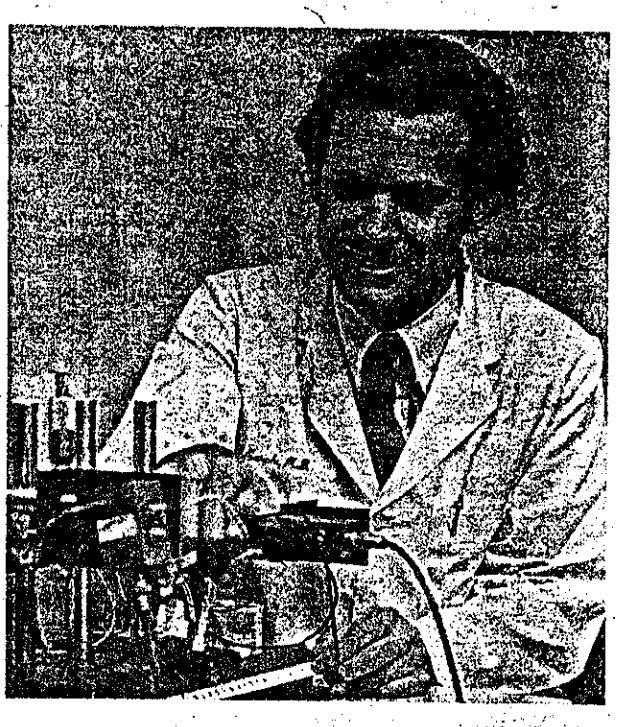
When optical rotation occurs, an optically active substance (glucose in this case) changes the plane of polarized light so that the light rotates in an arc. The length of the arc is proportional to the concentration of the substance.

Wayne F. March, MD, University of Oklahoma Medical Center, told a Research to Prevent Blindness seminar in Los Angeles that "radioactively tagged glucose has been monitored noninvasively in the living rabbit by placing a probe on the eye. Furthermore, the optical rotation of [polarized light by] aqueous humor withdrawn from rabbit eyes has been shown to correspond with its glucose concentration and with glucose concentration in blood from the rabbits' ear veins."

March said that he and co-worker Bernard Rabinovitch, PhD, professor of biochemistry and ophthalmology, may soon be able to monitor fluctuations in blood glucose concentration in human eyes "by analyzing a beam of polarized light directed across the anterior chamber of the eye. Polarimetry and saccharimetry have been used for more than a century to measure glucose concentration in a test tube. If two polarizing plates are placed at right angles in a light beam, then theoretically no light will be transmitted.

"However, if an optically active substance is present—in the aqueous humor in this case—optical rotation will occur and light will pass. This amount of light corresponds to the amount of glucose present."

This work, said March, who is director of research development, Department of Ophthalmology, Dean A. McGee Eye Institute, has led them to the long-range concept of a new type of contact lens. In it would be implanted "a micro-miniature gallium arsenide laser, sending a pulsed infra-red beam to a silicon diode detector on the opposite side of the cornea. Such micro-miniature lasers and detectors already are in use in military range finders and in optical relays such as the new telephone systems.



Dr March with his equipment.

"In the eye, this equipment would measure optical rotation. The rest of this oxygen-permeable contact lens would be occupied by integrated circuitry. The power supply might be an inductive coil producing power from nearby radio sources. The optical rotation-glucose concentration information could be transmitted through a microwave telemetry transmitter. This information then might be printed out via a receiver in the patient's pocket or transmitted directly to an implanted insulin pump."

March explained that, if the information were relayed to an implanted pump, a safeguard input from some other source would probably be necessary. Thus, if the two sources of information about glucose did not agree, the pump would withhold insulin release.

At the moment, said March, prototype equipment still is too large for regular use in humans, and it is not possible to give a precise timetable of when studies with rabbits and other animals might lead to clinical trials.

Efforts to perfect a glucose sensor of course go hand-in-hand with the recent development of several practical insulin delivery devices, he added.

—by PHIL GUNBY