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SYMPOSIUM

Detection of Trace Glucose on the Surface of a Semipermeable Membrane Using a Fluorescently Labeled Glucose-Binding Protein: A Promising Approach to Noninvasive Glucose Monitoring

Xudong Ge, Ph.D.,[1] Govind Rao, Ph.D.,[1] Yordan Kostov, Ph.D.,[1] Sunsanee Kanjananimmanont, B.S.,[1] Rose M. Viscardi, M.D.,[2] Hyung Woo, M.D.,[2] and Leah Tolosa, Ph.D.[1]

Abstract

Background:

Our motivation for this study was to develop a noninvasive glucose sensor for low birth weight neonates. We hypothesized that the underdeveloped skin of neonates will allow for the diffusion of glucose to the surface where it can be sampled noninvasively. On further study, we found that measurable amounts of glucose can also be collected on the skin of adults.

Method:

Cellulose acetate dialysis membrane was used as surrogate for preterm neonatal skin. Glucose on the surface was collected by saline-moistened swabs and analyzed with glucose-binding protein (GBP). The saline-moistened swab was also tested in the neonatal intensive care unit. Saline was directly applied on adult skin and collected for analysis with two methods: GBP and high-performance anion-exchange chromatography (HPAEC).

Results:

The amount of glucose on the membrane surface was found (1) to accumulate with time but gradually level off, (2) to be proportional to the swab dwell time, and (3) the concentration of the glucose solution on the opposite side of the membrane. The swab, however, failed to absorb glucose on neonatal skin. On direct application of saline onto adult skin, we were able to measure by HPAEC and GBP the amount of glucose collected on the surface. Blood glucose appears to track transdermal glucose levels.

Conclusions:

We were able to measure trace amounts of glucose on the skin surface that appear to follow blood glucose levels. The present results show modest correlation with blood glucose. Nonetheless, this method may present a noninvasive alternative to tracking glucose trends.

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Author Affiliations: [1]Center for Advanced Sensor Technology, Department of Chemical, Biochemical, and Environmental Engineering, University of Maryland, Baltimore County, Baltimore, Maryland; and [2]Division of Neonatology, Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland

Abbreviations: (GBP) glucose-binding protein, (HPAEC) high-performance anion-exchange chromatography, (NICU) neonatal intensive care unit, (PBS) phosphate-buffered saline, (PED) pulsed electrochemical detection, (SC) stratum corneum, (TEWL) transepidermal water loss, (TG) transdermal glucose

Keywords: blood glucose, fluorescence, glucose-binding protein, neonate, noninvasive

Corresponding Author: Leah Tolosa, Ph.D., Center for Advanced Sensor Technology, Department of Chemical, Biochemical, and Environmental Engineering, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, Maryland 21250; email address leah@umbc.edu