Journal of Diabetes Science and Technology
Volume 4, Issue 5, September 2010
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SYMPOSIUM

Quantifying the Composition of Human Skin for Glucose Sensor Development

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Abstract

Background:

Glucose is heterogeneously distributed within human skin. In order to develop a glucose measurement method for human skin, both a good quantification of the different compartments of human skin and an understanding of glucose transport processes are essential. This study focused on the composition of human skin. In addition, the extent to which intersubject variability in skin composition alters glucose dynamics in human skin was investigated.

Methods:

To quantify the composition of the three layers of human skin—epidermis, dermis, and adipose tissue—cell and blood vessel volumes were calculated from skin biopsies. These results were combined with data from the literature. The composition was applied as input for a previously developed computational model that calculates spatiotemporal glucose dynamics in human skin. The model was used to predict the physiological effects of intersubject variability in skin composition on glucose profiles in human skin.

Results:

According to the model, the lag time of glucose dynamics in the epidermis was sensitive to variation in the volumes of interstitial fluid, cells, and blood of all layers. Data showed most variation/uncertainty in the volume composition of the adipose tissue. This variability mainly influences the dynamics in the adipose tissue.

Conclusions:

This study identified the intersubject variability in human skin composition. The study shows that this variability has significant influence on the glucose dynamics in human skin. In addition, it was determined which volumes are most critical for the quantification and interpretation of measurements in the different layers.

J Diabetes Sci Technol 2010;4(5):1032-1040

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Abbreviation: (ISF) interstitial fluid, (LVCS) lymphatic vessel cross sections, (OGTT) oral glucose tolerance test, (PSA) parameter sensitivity analysis, (SC) stratum corneum

Keywords: glucose, histology, interstitial fluid, modeling, skin

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