

Fiber-Coupled Fluorescence Affinity Sensor for 3-Day *in Vivo* Glucose Sensing

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Abstract

Background:

To evaluate the feasibility of an implantable fiber-coupled fluorescence affinity sensor (FAS) for glucose monitoring in humans, we studied the acute and chronic *in vivo* performance in hairless rats and pigs.

Methods:

The implantable fiber-coupled FAS was constructed by filling a dialysis chamber made of a regenerated cellulose membrane mounted to the distal tip of an optical fiber with fluorescent chemistry based on concanavalin A. Blood sugar changes in animals were induced by injections of insulin and dextrose. Determination of interstitial glucose concentrations in skin tissue was facilitated by measuring the fluorescence response of the FAS.

Results:

The acute *in vivo* response of the fiber-coupled FAS exhibited good correlation coefficients (>0.77) with blood sugar changes and minimal lag times (2–10 min) after 2 hours of sensor implantation. Equilibrium of the sensor signal with interstitial fluid was required less than 60 min after implantation. For both rats and pigs, chronic response of the FAS to blood sugar modulations measured during the third day of implantation successfully demonstrated proof-of-concept for short-term glucose monitoring. A slight decrease in sensitivity after 3 days in the small animal model was assumed to be caused by excessive mechanical forces on the implanted device because of high animal motility.

Conclusions:

Overall, the chronic *in vivo* performance of the FAS in two different animal models over 3 days was clinically acceptable and comparable to other continuous glucose monitoring platforms. The major benefit of the FAS is the absence of “autodestructive” side products and any device-related warm-up time after sensor reconnection.

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Abbreviations: (CGMS) continuous glucose monitoring system, (Con A) concanavalin A, (FRET) fluorescence resonance energy transfer, (FAS) fluorescence affinity sensor, (IP) intraperitoneally, (ISF) interstitial fluid, (POF) polymer optical fiber, (STS) short-term sensor

Keywords: affinity, concanavalin A, dextran, diabetes, fluorescence, glucose monitoring, hollow fiber

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