

TOWARDS REAGENT-FREE CONTINUOUS BLOOD GLUCOSE MONITORING FOR THE CRITICAL CARE ENVIRONMENT USING MICRO-DIALYSIS AND INFRARED SPECTROMETRY

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For clinical research, in-vivo blood glucose monitoring is an ongoing important topic to improve glycemic control in patients with non-adequate blood sugar regulation. In particular, for patients under critically ill conditions, the intensive insulin therapy treatment cuts mortality rates by 42 % compared to standard therapy for intensive care indication [1]. Despite the existence of commercially available, mainly amperometric biosensors for glucose monitoring [2], continued interest is in spectroscopic techniques for reagent-free glucose monitoring, avoiding frequent recalibration of the sensor. Infrared-spectroscopy of body fluids has been established as a convenient and sensitive technique for glucose determination in whole blood and blood dialysates. For stable long-term operation, a switch-flow system was developed that enables quasi-continuous glucose monitoring within a set-up including a micro-dialysis probe. One problem, when using micro-dialysis probes previously in-line in combination with flow-through transmission cells, is the high backpressure resulting from the infrared cuvette dimensions and the low inner diameter of the connecting tubing within the fluidic system, which led to larger perfusate losses through the dialysis probe membrane. The benefit of the new system is the complete decoupling of the dialysis flow stream from the fluidics that incorporates the infrared cuvette.

The novel fluidics system includes two syringe pumps, one for the perfusate flow through the dialysis probe and the second for the transport of the sample to the IR-sensor system. An electronically controlled 6-port injection valve with sample loop is used as a decoupling unit between the two flow-streams. It is advantageous that the flow to the IR-spectrometer can be adjusted to the user's needs with regard to a fast sample transport and an appropriate measurement time window for spectral recording. Furthermore, the possibility for spectral background measurements before each sample injection exists, offering excellent drift-free IR-measurements over extended operation periods and leading to utmost reliability of the sensing system. Multivariate calibration is required for glucose concentration prediction due to the complex composition of dialysates from interstitial body fluid. Quantitative results obtained from similar dialysates from more than 80 human EDTA-blood plasma samples will be presented.

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