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SYMPOSIUM

Automated Blood Sampling and Glucose Sensing in Critical Care Settings

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Abstract

Background:
Tight glycemic control (TGC) studies in intensive care units (ICU) have shown substantial improvements in clinical outcomes. However, implementation of TGC in ICU practice is partly constrained by the lack of automated continuous blood glucose monitoring systems that can facilitate clinically accurate feedback of glycemic data. The aim of this work is to develop a portable automated blood sampling system for integration with a glucose sensor for use in critical care settings.

Methods:
Clinical prototypes for glucose sensing in blood were developed based on two distinct technologies: mid-infrared laser absorption spectroscopy and electrochemistry. Concurrently, an automated peripheral venous blood sampling system was developed for integration with the glucose sensing system.

Results:
The glucose sensing prototypes were validated clinically with various biological samples in a continuous mode. A customized micropump was employed in conjunction with a novel peripheral venous catheter system to automatically sample blood from the subject's forearm. Microvolumes of blood were sampled in continuous and intermittent modes at clinically relevant user-defined frequencies. The clinical feasibility of blood sampling, along with continuous glucose sensing, was demonstrated.

Conclusion:
Cascade's automated peripheral venous blood sampling system, in combination with a flow-through glucose sensor system, offers several advantages over current state-of-the-art systems. This includes the potential for significantly improved workflow in the ICU, minimal discomfort to the patient, and accurate glucose measurement in whole blood, thus helping achieve tight glycemic control.

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Abbreviations: (FAD) flavin adenine dinucleotide, (FTIR) Fourier transform infrared, (GOx) glucose oxidase, (ICU) intensive care unit, (ISF) interstitial fluid, (QCL) quantum cascade lasers, (TGC) tight glycemic control

Keywords: automated blood sampling, continuous glucose monitoring, mid-infrared quantum cascade laser spectroscopy, tight glycemic control

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