

An Automated Discontinuous Venous Blood Sampling System for *Ex Vivo* Glucose Determination in Humans

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Abstract

Background:

Intensive insulin therapy reduces mortality and morbidity in critically ill patients but places great demands on medical staff who must take frequent blood samples for the determination of glucose levels. A cost-effective solution to this resourcing problem could be provided by an effective and reliable automated blood sampling (ABS) system suitable for *ex vivo* glucose determination.

Method:

The primary study aim was to compare the performance of a prototype ABS system with a manual reference system over a 30 h sampling period under controlled conditions in humans. Two venous cannulae were inserted to connect the ABS system and the reference system. Blood samples were taken with both systems at 15, 30, and 60 min intervals and analyzed using a Beckman glucose analyzer. During the study, blood glucose levels were altered through four meal ingestions.

Results:

The median Pearson coefficient of correlation between manually and automatically withdrawn blood samples was 0.976 (0.953–0.996). The system error was $-3.327 \pm 5.546\%$ (-6.03–0.49). Through Clark error grid analysis, 420 data pairs were analyzed, showing that 98.6% of the data were in zone A and 1.4% were in zone B. Insulin titration error grid analysis revealed an acceptable treatment in 100% of cases. A 17.5-fold reduction in the occurrence of blood-withdrawal failures through occluded catheters was moreover achieved by the added implementation in the ABS system of a “keep vein open” saline infusion.

Conclusions:

Our study showed that the ABS system described provides a user-friendly, reliable automated means for reproducible and accurate blood sampling from a peripheral vein for blood glucose determination and thus represents a promising alternative to frequent manual blood sampling.

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Abbreviations: (ABS) automated blood sampling, (APTT) activated partial thromboplastin time, (CEGA) Clark error grid analysis, (CLINICIP) Closed Loop INsulin Infusion for Critically Ill Patients, (ICU) intensive care unit, (ITEGA) insulin titration error grid analysis, (KVO) keep vein open

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