Effects of Everyday Life Events on Glucose, Insulin, and Glucagon Dynamics in Continuous Subcutaneous Insulin Infusion–Treated Type 1 Diabetes: Collection of Clinical Data for Glucose Modeling

Background: In the development of glucose control algorithms, mathematical models of glucose metabolism are useful for conducting simulation studies and making real-time predictions upon which control calculations can be based. To obtain type 1 diabetes (T1D) data for the modeling of glucose metabolism, we designed and conducted a clinical study.

Methods: Patients with insulin pump–treated T1D were recruited to perform everyday life events on two separate days. During the study, patients wore their insulin pumps and, in addition, a continuous glucose monitor and an activity monitor to estimate energy expenditure. The sequence of everyday life events was predetermined and included carbohydrate intake, insulin boluses, and bouts of exercise; the events were introduced, temporally separated, in different orders and in different quantities. Throughout the study day, 10-min plasma glucose measurements were taken, and samples for plasma insulin and glucagon analyses were obtained every 10 min for the first 30 min after an event and subsequently every 30 min.

Results: We included 12 patients with T1D (75% female, 34.3±9.1 years old [mean±SD], hemoglobin A1c 6.7±0.4%). During the 24 study days we collected information-rich, high-quality data during fast and slow changes in plasma glucose following carbohydrate intake, exercise, and insulin boluses.

Conclusions: This study has generated T1D data suitable for glucose modeling, which will be used in the development of glucose control strategies. Furthermore, the study has given new physiologic insight into the metabolic effects of carbohydrate intake, insulin boluses, and exercise in continuous subcutaneous insulin infusion–treated patients with T1D.