

Postprandial Glycemic Excursions with the Use of a Closed-Loop Platform in Subjects with Type 1 Diabetes: A Pilot Study

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Abstract

Background:

The aim of this study was to evaluate the efficacy of a proportional derivative algorithm closed-loop system to control postprandial glucose concentrations in subjects with type 1 diabetes.

Methods:

Six subjects treated with continuous subcutaneous insulin infusion received a standardized meal on three days. The first day served as control, the second day as learning experiment for the algorithm, and the third day to compare the closed loop to the control day. Venous blood glucose was measured as reference until 300 min postprandially. The artificial pancreas platform consisted of a subcutaneous continuous glucose monitor (CGM), the GlucoDay[®] S (Menarini Diagnostics), two D-Tron+ pumps (Disetronic Medical Systems) for subcutaneous insulin, and glucagon administration connected to a personal computer.

Results:

One subject was excluded due to technical failure of the CGM. Two of five subjects were male, mean age was 50.8 years (range 38–60), and mean hemoglobin A1c was 8.7% (range 7.0–12.2). The mean postprandial venous blood glucose concentration of day 1 was 205 mg/dl (range 94–265 mg/dl) compared with 128 mg/dl (range 128–158 mg/dl) on day 3 ($p = .14$). Percentage of time spent in euglycemia postprandially on day 1 was 31% versus 60% on day 3 ($p = .08$). Time spent below 3.9 mmol/liter (70 mg/dl) was 19% on day 1 compared with 11% on day 3 ($p = 1.0$). Time above 10 mmol/liter (180 mg/dl) on day 1 was 60% versus 29% on day 3 ($p = .22$).

Conclusion:

The artificial pancreas provided comparable postprandial glycemic control to usual care.

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Abbreviations: (AUC) area under the curve, (CSII) continuous subcutaneous insulin infusion, (CGM) continuous glucose monitor, (MPC) model predictive control

Keywords: closed loop, diabetes, postprandial glucose control, proportional derivative algorithm

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