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SYMPOSIUM

A Novel Adaptive Basal Therapy Based on the Value and Rate of Change of Blood Glucose

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Abstract

Background:
Modern insulin pump therapy for type 1 diabetes mellitus offers the freedom to program several basal profiles that may accommodate diurnal variability in insulin sensitivity and activity level. However, these basal profiles do not change even if a pending hypoglycemic or hyperglycemic event is foreseen. New insulin pumps could receive a direct feed of glucose values from a continuous glucose monitoring (CGM) system and could enable dynamic basal adaptation to improve glycemic control.

Method:
The proposed method is a two-step procedure. After the design of an initial basal profile, an adaptation of the basal rate is suggested as a gain multiplier based on the current CGM glucose value and its rate of change (ROC). Taking the glucose value and its ROC as axes, a two-dimensional plane is divided into a nine-zone mosaic, where each zone is given a predefined basal multiplier; for example, a basal multiplier of zero indicates a recommendation to shut off the pump.

Results:
The proposed therapy was evaluated on 20 *in silico* subjects (ten adults and ten adolescents) in the Food and Drug Administration-approved UVa/Padova simulator. Compared with conventional basal therapy, the proposed basal adjustment improved the percentage of glucose levels that stayed in the range of 60–180 mg/dl for all 20 subjects. In addition, the adaptive basal therapy reduced the average blood glucose index values.

Conclusions:
The proposed therapy provides the flexibility to account for insulin sensitivity variations that may result from stress and/or physical activities. Because of its simplicity, the proposed method could be embedded in a chip in a future artificial pancreatic β cell or used in a "smart" insulin pump.

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Abbreviations: (BG) blood glucose, (BGI) blood glucose index, (CGM) continuous glucose monitoring, (FDA) Food and Drug Administration, (ROC) rate of change, (TDD) total daily dose, (T1DM) type 1 diabetes mellitus

Keywords: adaptive basal therapy, artificial pancreatic β cell, glucose prediction, type 1 diabetes mellitus, UVa/Padova simulator

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