

Prediction of the Risk to Develop Diabetes-Related Late Complications by Means of the Glucose Pentagon Model: Analysis of Data from the Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study

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Abstract

Background:

By taking parameters into account that describe the variability of continuously monitored glucose and long-term metabolic control [hemoglobin A1c (HbA1c)], the glucose pentagon model (GPM) allows characterization of the glucose profile of individual patients with diabetes in a graphical format. A glycemic risk parameter (GRP) derived from this model might allow a better prognosis of the risk to develop diabetes-related complications than the HbA1c.

Methods:

To evaluate this hypothesis, we analyzed a subset of data from the Juvenile Diabetes Research Foundation continuous glucose monitoring (CGM) study. The values of the different parameters that are integrated in the GPM were extracted automatically from CGM profiles registered before and after 6 months by means of the Medtronic CGM system in 108 patients.

Results:

In these patients, the significant reduction in HbA1c from 7.4% to 7.0% was accompanied by a reduction in glycemia from 164 to 156 mg/dl, standard deviation from 61 to 57 mg/dl, area under the curve >160 mg/dl 29.2 to 23.1, and time per day >160 mg/dl 634 to 576 min. This led to a subsequent reduction in GRP from 3.3 to 2.7; this decrease by 18.2% was significantly larger than that in HbA1c by 8.6% ($p < .001$). Changes in individual GPMs/GRPs support this observation. They also show the impact of high glycemic variability on GPM/GRP.

Conclusions:

Our analysis of data of a study with a considerable sample size and study duration showed that the GPM is not only helpful for rapid assessment of individual glycemic profiles and how therapeutic interventions influence these, but also appears to provide a better prognosis of the risk to develop late complications than the HbA1c *per se*. However, it is also clear that a true validation of such a model requires performance of a long-term study in a large number of patients with diabetes.

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Abbreviations: (AUC) area under the curve, (CIT) conventional insulin therapy, (DCCT) Diabetes Control and Complications Trial, (DRLC) diabetes-related late complications, (GPM) glucose pentagon model, (GRP) glycemic risk parameter, (GV) glycemic variability, (HbA1c) hemoglobin A1c, (JDRF) Juvenile Diabetes Research Foundation, (MDI) multiple daily injections, (SMBG) self-monitoring of blood glucose, (UKPDS) UK Prospective Diabetes Study

Keywords: continuous glucose monitoring, diabetes late complications, glycosylated hemoglobin, metabolic control, risk factors, risk prognosis

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