Assessment of Impaired Fasting Glucose in Obese and Overweight Insulin-Resistant Children by Continuous Glucose Monitoring

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The childhood obesity epidemic has been accompanied by an increase in the prevalence of type 2 diabetes mellitus, with impaired glucose tolerance (IGT) reported in 10–27% of obese children and adolescents across the globe.[1,2] The natural history of impaired fasting glucose (IFG) and IGT is variable, with ~25% progressing to diabetes, 50% remaining in their abnormal glycemic state, and 25% reverting to normal glucose tolerance over an observational period of 3–5 years.[3]

Glycemic variability generates oxidative stress and potentially contributes to the development of both macrovascular and microvascular complications in prediabetes and diabetes. Mean amplitude of glycemic excursions (MAGE) is an established parameter for glycemic variability and is known to have a strong correlation with the markers of oxidative stress (urinary 8-iso-prostaglandin F2 levels).[4–6] Continuous glucose monitoring (CGM) provides extensive glucose data that can be used to calculate MAGE. Hyperinsulinemia, commonly seen prior to frank glucose elevations, is assumed to result in maintenance of euglycemia. However, daily glycemic excursions in children with prediabetes (IGT and/or IFG) and insulin resistance are not known and may be more significant than expected based on standard oral glucose tolerance tests.

We studied a group of obese children followed at the pediatric endocrinology center at Weill Cornell Medical College/New York Presbyterian Hospital who had insulin resistance with either normal glucose tolerance (group 1) or IFG/IGT (group 2). Subjects were excluded if they (1) had diabetes, (2) were on steroid or metformin therapy, or (3) had chronic systemic illnesses. Continuous glucose monitoring was performed using the iPro® Professional CGM System (Medtronic Diabetes, Northridge, CA).

There were 17 subjects (14 females) with a mean age of 13.4 ± 2.7 years. There were 7 subjects in group 1 (IFG and IGT) and 10 subjects in group 2 (insulin resistant) group. The mean hemoglobin A1c was 6.3% ± 0.6% in group 1 and 5.8% ± 0.19% in group 2. The mean body mass index was similar in both groups. The mean glucose as measured by CGM was 114.9 ± 10.7 mg/dl in group 1 and 103.3 ± 11.9 mg/dl in group 2. The insulin-resistant group had a MAGE value of 26.4 ± 7.4, and the IGT group had a MAGE value of 28.3 ± 8.9. Interestingly, the majority of subjects (7 out of 10) in the insulin-resistant group had glucose values over 100 mg/dl (IFG) in the late morning fasting hours (4:00 AM to 6:00 AM), a finding not seen on their oral glucose tolerance test (**Figure 1**). Importantly, these overnight glucose values were elevated to a degree similar to those seen in the IGT group.

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Abbreviations: (CGM) continuous glucose monitoring, (IFG) impaired fasting glucose, (IGT) impaired glucose tolerance, (MAGE) mean amplitude of glycemic excursions

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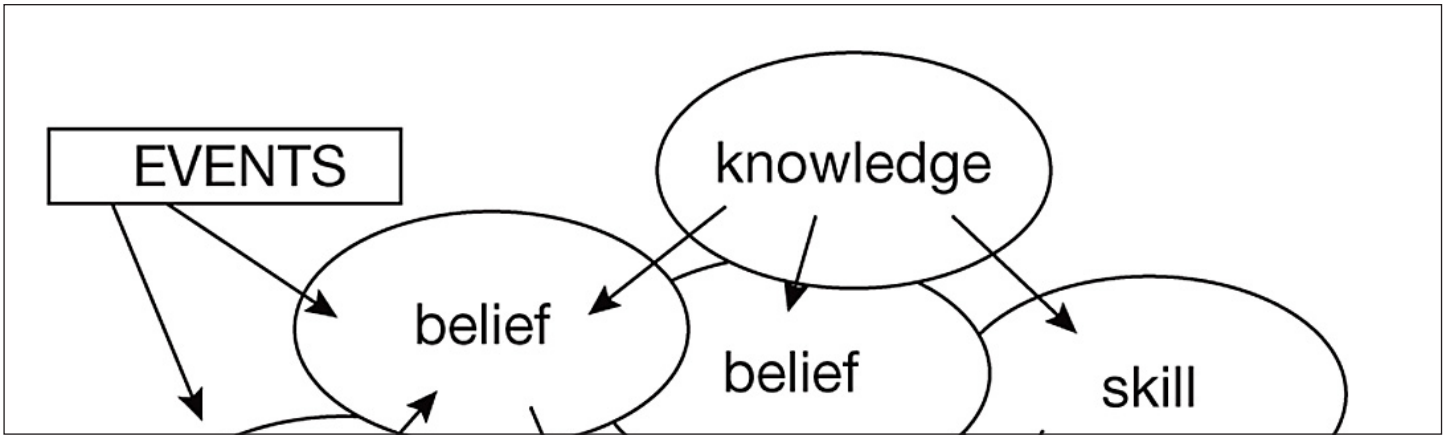

Figure 1. Overnight data in the two groups. The diamonds show mean glucose in the individual subjects in the two groups during the fasting state (4:00 AM to 6:00 AM) obtained from CGM. The thick line represents a 100 mg/dl glucose value, above which is considered impaired in the fasting state.

The preliminary data show that CGM was able to detect glucose elevations, especially during the overnight period, that were missed in the insulin-resistant subjects' fasting glucose level during the oral glucose tolerance test. Such data would be critical in creating a more aggressive treatment plan for at-risk children and argues for CGM as an added early screening tool for dysglycemia in insulin-resistant children.

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