Translating the HbA1c assay into estimated average glucose values in children and adolescents with type 1 diabetes mellitus (T1DM)

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Introduction

Clinical trials have demonstrated the association between HbA1c and both microvascular and macrovascular complications in type 1 diabetes mellitus (DM-1)

In meta-analysis studies real-time CGM appears more effective than self-monitoring of blood glucose (SMBG) in type 1 diabetes

We recorded and analyzed the level of HbA1c in relation to different glucose parameters over 5 days and measured the 24 h mean blood glucose (MBG) from in 50 children with type 1 diabetes mellitus .
Correlation studies were performed between glucose parameters measured by CGMS and HbA1c level.

Methods and Materials

Fifty randomly selected children with T1DM (aged between 3 and 15 years) were included in this study. They had the onset of DM-1 for more than 6 months and were able to perform finger stick glucose testing four times daily

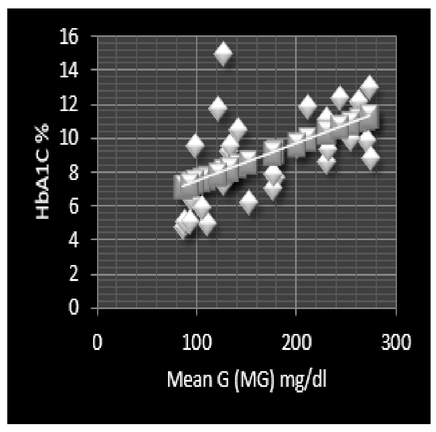
The Medtronic (Northridge, CA) MiniMed CGMS® Gold sensor was used as the CGMS in all children for 5 days prior to measuring HbA1c.

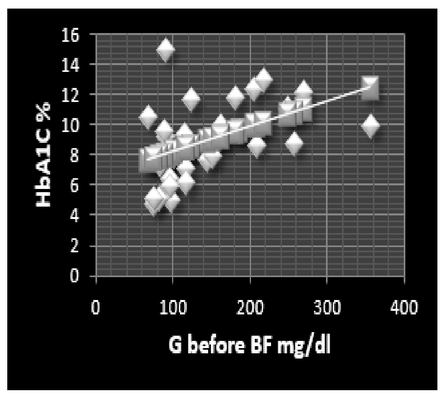
Children and their parents were instructed to enter their daily blood glucose finger sticks (morning, lunch, dinner, and before bedtime) into the device for calibration, and children were blinded to the sensor reading.

All participants completed CGMS for 5 consecutive days before testing their HbA1c levels. The 24 h mean blood glucose (MBG) and glucose standard deviation values (GSD), BG concentrations before and 2 h after breakfast, lunch and dinner, and the number of high (>250 mg/dL) and low ((<60 mg/dL) excursions were recorded.

Results

The glycemic parameters measured by CGMS 5 days before measuring HbA1c in our 50 children with DM-1 with variable glycemic control are reported in table. 24 h MG was positively correlated with HbA1c (r = 0.90, P<0.001) in all children with DM-1. In addition, the HbA1C was correlated significantly with BG SDS, BG before and after breakfast and BG after lunch.





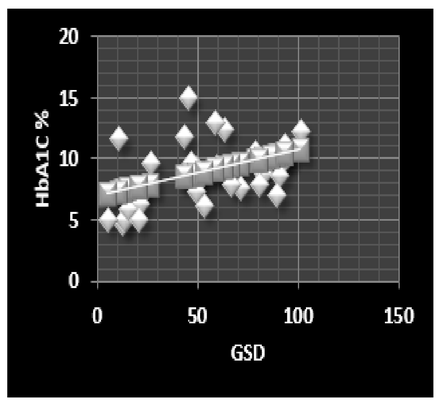


Figure 1: Regression of mean glucose (MG) and HbA1C level.

Figure 2: Regression of mean G before breakfast and HbA1C level.

Figure 3: Regression of GSD and HbA1C level.

Our data based on our equation		Published data (Ref. 8)	
HbA1c %	AG mg/dL	HbA1c	AG mg/dL
4	80		
4.446	90		
4.94	100		
5.4	110		
5.9	120	6	126
6.4	130	6.5	140
6.9	140	7	154
7.4	150	7.5	169
7.9	160	8	183
8.4	170	8.5	197
8.9	180	9	212
9.4	190	9.5	226
9.9	200	10	240
10.9	220	10.5	255
11.9	240	11	269
12.8	260	11.5	283
13.8	280	12	298
14.8	300	13	341

Table 2. Correlation between HbA1c and CGMS glycemic data

	R	p
MG	0.90	0.00001**
GSD	0.43	0.026*
G before breakfast	0.450362	0.014
G after breakfast	0.543387	0.0023 *
G before lunch	0.340357	0.070
G after lunch	0.406634	0.028*
G before dinner	0.218728	0.254
G after dinner	0.343988	0.067
MAD	0.079114	0.683
Number of largest excursions	0.196	0.12
Number of lowest excursions	0.410241	0.027*

* P<0.05, ** P<0.001; Abbreviations: Mean G=mean glucose for 5 days, GSD=glucose standard deviation values, MAD=median absolute percent difference (denoting glucose variability) and A1C level.

Conclusions

Our study showed a linear relationship between A1C and AG values measured by CGMS for 5 days before HbA1c measurement.

The AG can be easily calculated using a formula derived in our study, HbA1c = 0.0494 MG- 2E-14.

The proper use of CGMS enables monitoring glucose variability and can help controlling glucose fluctuations.

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