Contribution of Glucose Variability to HbA1C Levels in Patients With Type 1 Diabetes

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Background

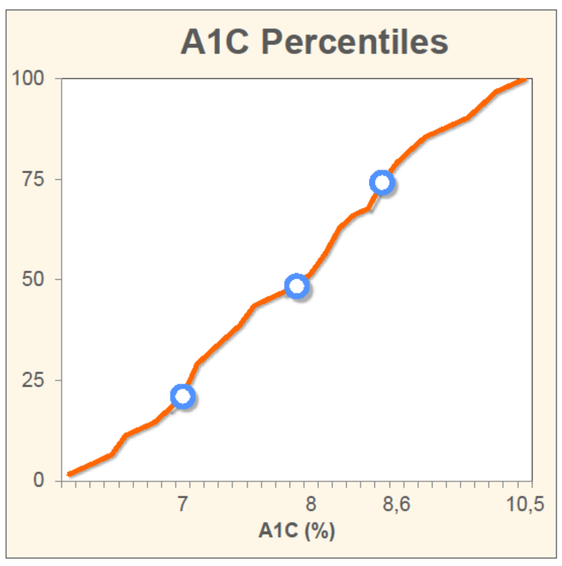
Optimal management of type 1 diabetes requires full understanding of the relationships between the triad: HbA1C, fasting plasma glucose, and glucose variability (GV). Total glucose exposure, including postprandial hyperglycaemia and glucose variability, should be considered in the evaluation of the patient's risk for complications. As GV may contribute to hemoglobin glycation we assessed the influence of GV in HbA1C levels.

Research Design and Methods

We retrospectively analysed 9,393 hours of continuous glucose monitorings (CGMs) from 61 patients with type 1 diabetes. Periods of 24 hours with missing values were excluded. We calculated various measures of GV and used a regression model to determine the impact of each GV measure to HbA1C level. GV was calculated using EasyGV© software and CGMs were recorded using iPro™2 (Medtronic, Northridge, CA).

Sample Characteristics

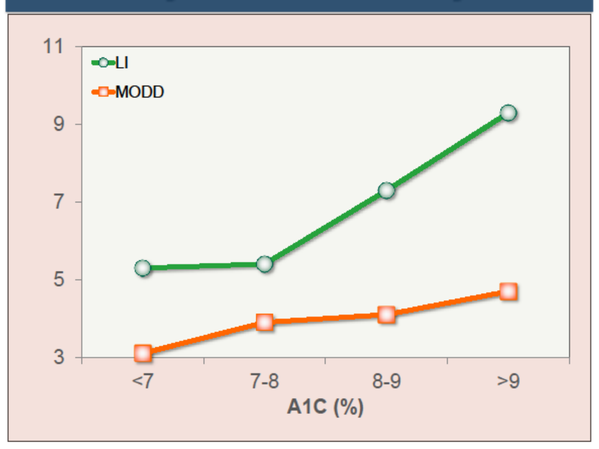
Gender (female)	57%
Age (years)	30.0±9.2
Duration of T1D (years)	17.7±9.6
Insulin therapy	
MDI	63.5%
CSII	36.5%
Total daily dosage	44.8±20.5
BMI (Kg/m²)	22.8±7.6
HbA1C (%)	7.9±1.1



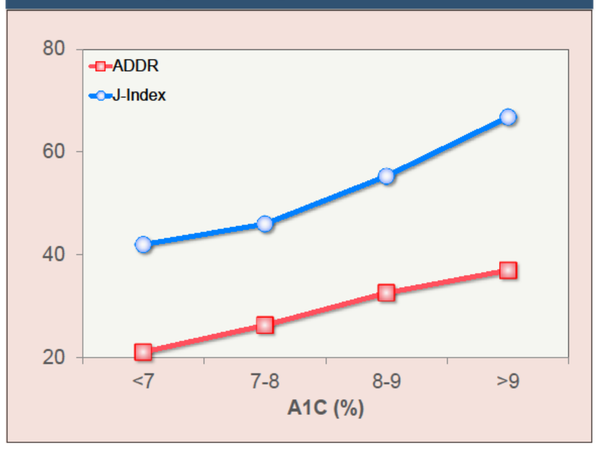
Glucose Variability

	A1C (%) < 7%	7-8%	8-9%	> 9%	*P*
SD	2.8±1.1	3.4±0.8	3.8±0.8	4.24±1.1	**0.011**
CONGA	7.3±1.8	7.4±1.6	8.1±1.3	8.8±2.0	0.099
MAG	2.2±0.9	2.2±0.4	2.5±0.5	2.8±1.0	0.104
LI	5.3±5.3	5.4±2.3	7.3±3.4	9.3±6.1	**0.017**
MAGE-CGM	5.5±1.6	6.6±1.5	7.1±2.0	8.2±4.1	0.218
MODD	3.1±1.1	3.9±1.0	4.1±0.9	4.7±1.5	**0.041**
ADDR	21.1±11.5	26.3±8.9	32.6±9.9	37.0±12.5	**0.012**
M-value	12.9±7.3	15.0±6.6	16.5±7.3	23.0±13.8	0.333
J-index	42.0±16.0	46.0±18.0	55.3±15.7	66.8±26.6	**0.033**
HBGI	8.7±5.3	9.8±4.2	12.0±4.1	15.1±6.7	**0.041**
GRADE	7.2±4.7	7.0±3.7	8.3±3.4	9.9±5.6	0.396
%Hipoglycemia	10.9±13.0	14.7±14.7	9.3±9.9	9.3±10.8	
%Euglycemia	5.1±3.0	5.6±2.6	5.5±2.3	3.6±2.3	
%Hiperglycemia	84.0±12.8	79.7±15.5	85.1±9.9	87.1±10.9	

Glycemic Variability



Quality of Glycemic Control



	A1C Coefficient	A1C *P*	MODD Coefficient	MODD *P*
SD	0.262	< 0.001	0.541	< 0.001
CONGA	0.373	< 0.001	0.450	< 0.001
MAG	0.264	< 0.001	0.464	< 0.001
LI	0.282	< 0.001	0.486	< 0.001
MAGE-CGM	0.192	< 0.001	0.441	< 0.001
MODD	0.329	< 0.001	-	-
ADDR	0.502	< 0.001	0.801	< 0.001
M-value	0.235	< 0.001	0.537	< 0.001
J-index	0.404	< 0.001	0.538	< 0.001
HBGI	0.353	< 0.001	0.566	< 0.001
GRADE	0.312	< 0.001	0.414	< 0.001

Contribution of Intra and Interday Variability to A1C Levels

Intraday Variability 4-16%

SD: 10.2%, CONGA: 15.7%, MAGE: 3.9%, and MAG 8.1%, p<0.05

Interday Variability 13%

MODD: 13.1%

Conclusion

GV contributes significantly to HbA1c levels. This effect is more pronounced at higher HbA1c levels. Interday variability was the most important contributor to HbA1C. GV impairs significantly the quality of glycemic control of type 1 diabetic patients.

SD: standard deviation; CONGA: continuous overlapping net glycemic action; MAG: mean absolute glucose; LI: lability index; MAGE-CGM: mean amplitude of glucose excursions; MODD: mean of daily differences; ADDR: average daily risk ratio; HBGI: high blood glucose index; GRADE: glycemic risk assessment of diabetes equation

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Diabetes (to include obesity, pathophysiology & epidemiology)

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