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Reduced Glycemic Variability With Yoga in Patients With Type 2 Diabetes Mellitus: Results of a Pilot Study

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Keywords
complications, exercise, glucose fluctuations, glycemic variability, type 2 diabetes, yoga

Glycemic variability (GV) in type 2 diabetes mellitus (T2DM) is associated with increased risk of complications, especially macrovascular complications,[1,2] by increasing oxidative stress, proinflammatory markers, and advanced glycation end products (AGE).[3] Yoga is a widely used complementary therapy in the management of T2DM and has multiple benefits including reduction in fasting plasma glucose, postprandial glucose, HbA1C, oxidative stress, and proinflammatory markers.[4] The objective of our study is to understand the effect of yoga on glycemic variability in T2DM.

Ten T2DM patients, 40-70 years of age, were recruited for the study. Mean baseline HbA1C was 7.50% (±1.87) and age 55 (±12.78). Continuous glucose monitoring was done for 14-day using flash glucose monitoring system sensor, Freestyle Libre Pro (Abbott Diabetes Care Ltd, Oxon, UK). Participants were instructed to continue with same lifestyle without any further modifications for the next 14 days. A consultant endocrinologist ensured that medication dosages of the patients are adequate and require no modification till the end of the study period. Baseline glycemic variability was established in the first 7 days, followed by 7 days of yoga intervention. A validated conventional yoga module involving *asanas* (physical postures), *pranayama* (breathing practices), and *dhyana* (meditation) was taught. Statistical analysis was performed using statistical package for social sciences (SPSS version 22.0). Normality of distribution measured using the Shapiro-Wilk test, and the appropriate statistical test for within-group analysis was performed using paired sample *t*-test.

Results

Nine participants completed the study. One dropped out due to personal reasons not relevant to the study. One patient was on insulin and the rest were on oral glucose lowering agents. A significant reduction in glycemic variability was observed in all measures of GV. Continuous overlapping net glycemic action (CONGA), mean of daily differences (MODD), and standard deviation (SD) reduced significantly (Table 1). Sustenance of the euglycemic target range, measured using glycemic risk assessment in diabetes equation (GRADE), average daily risk ratio (ADDR), and J Index, also significantly increased.

Discussion

A significant reduction in GV and higher percentage of time within the glycemic target was observed after one week of yoga practice. To our knowledge this is the first ever study exploring the effect of yoga on glycemic variability in T2DM. In our study, short-term yoga practice (7 days) showed a statistically significant reduction in GV. The possible mechanism of action might be through enhanced parasympathetic activity with yoga.[5] A strong correlation was observed between the baseline pre and post mean glucose levels, and between baseline glucose level and measures of GV. Our findings have a high translational value, as reducing glycemic variability would possibly help reduce oxidative stress, proinflammatory markers, and associated cardiovascular complications of T2DM, in a more sustainable and cost-effective manner. Likewise, reduction in blood glucose levels observed on a "glucose-dependent manner" would benefit patients at higher risk of hypoglycemia. The moderate intensity of yoga would make it a more preferable and safer mode of physical activity in the management of T2DM with reduced risk of hypoglycemia.

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Table 1. Comparison of Changes in Ambulatory Glucose Profile Before and After Yoga.

	Pre	Post	Difference	*P* value	Correlation coefficient (pre and post) *r*
Mean daily glucose (mmol/L)	8.35 ± 2.33	7.67 ± 2.05	0.68 ± 0.65	.014*	.96
SD	2.30 ± 0.86	1.99 ± 0.66	0.31 ± 0.36	.036*	.92
MODD	1.97 ± 0.71	1.67 ± 0.56	0.3 ± 0.38	.048*	.85
CONGA	7.38 ± 2.29	6.74 ± 1.99	0.64 ± 0.73	.031*	.95
GRADE	6.21 ± 5.85	4.79 ± 4.92	1.42 ± 1.74	.04*	.96
ADDR	19.73 ± 12.25	15.33 ± 9.25	4.4 ± 4.67	.022*	.94
J INDEX	39.44 ± 23.18	32.23 ± 18.07	7.21 ± 8.90	.041*	.94

*$P < .05$.

Abbreviations

ADDR, average daily risk ratio; CONGA, continuous overlapping net glycemic action; GRADE, glycemic risk assessment in diabetes equation; GV, glycemic variability, MODD, mean of daily differences; SD, standard deviation.

Authors' Note

Trial registration number: Clinical Trial Registry of India—CTRI/2017/11/010455 (www.ctri.in).

Declaration of Conflicting Interests

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