Clinical Effectiveness of Continuous Glucose Monitoring in Pregnancies Affected by Type 1 Diabetes

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BACKGROUND

•Glycemic control significantly affects the risk for developing adverse gestational health outcomes in pregnancies affected by type 1 diabetes (T1D)[1-4].

•HbA1C may not be the only glucose metric of importance in assessing adverse outcomes[5].

•Utilizing continuous glucose monitoring (CGM) in T1D pregnancies improved neonatal outcomes despite similarly low HbA1C levels between CGM and SMBG groups in a randomized controlled trial (RCT) in Europe and Canada[6].

•It is uncertain if CGM use in T1D pregnancies managed in a racially, ethnically, and socioeconomically diverse setting reduces adverse maternal outcomes in addition to neonatal outcomes.

STUDY OBJECTIVE

We examined the effect of glucose monitoring in T1D pregnancies managed with CGM compared to self-monitoring of blood glucose (SMBG) on various maternal and neonatal health outcomes.

METHODS

Study Design: Retrospective chart review of:
- T1D pregnancies in women 18-55 years of age,
- Using multiple daily injection therapy or insulin pump therapy, and
- Managed at the Barbara Davis Center for Diabetes (BDC) Pregnancy and Women's Health Clinic for pregnancy care at least once each trimester (unless delivery was before the 3rd trimester) between 1/1/14 and 8/31/20.

Data Collection: The electronic medical records were reviewed for baseline characteristics, point-of-care hemoglobin A1C levels (HbA1c), and various pregnancy visit data.

CGM Stratification: CGM use was defined as ≥60% wear in the 2nd and 3rd trimesters of pregnancy using raw CGM data from clinic software accounts.

HbA1c Goals: HbA1c goals were defined as ≤6.5% in the 1st trimester and ≤6% in the 2nd and 3rd trimesters, per guidelines by the American Diabetes Association[7].

Data Analysis: We compared outcomes between groups using student's t-tests for continuous variables and chi-squared tests for categorical variables.

RESULTS

Table 1. Baseline Characteristics

	CGM (n=82)	SMBG (n=78)	p-value
Age (years)	29.3 ± 5.1	28.5 ± 5.8	0.2315
Diabetes Duration (years)	15.3 ± 8.2	15.3 ± 6.3	0.9830
Race/Ethnicity, n (%)			0.6839
American Indian/Alaska Native	0 (0)	0 (0)	
Asian	1 (1.2)	0 (0)	
Hispanic	9 (11.0)	10 (12.8)	
Non-Hispanic Black	2 (2.4)	1 (1.3)	
Non-Hispanic White	61 (74.4)	61 (78.2)	
Other	9 (11.0)	6 (7.7)	
Insurance, n (%)			0.0055
Commercial	65 (79.3)	48 (61.5)	
Government	5 (6.1)	1 (1.3)	
Medicaid	10 (12.2)	24 (30.8)	
Other	2 (2.5)	5 (6.5)	
Gestational Age at First Pregnancy Visit (weeks)	6.5 ± 1.7	7.1 ± 2.3	0.0616
HbA1C at First Pregnancy Visit, n (%)	7.0 ± 1.3	7.4 ± 1.3	0.0638

Data are presented as mean ± standard deviation or n (%).
Abbreviations: CGM, continuous glucose monitoring; HbA1C, hemoglobin A1C; SMBG, self-monitoring of blood glucose.

Table 2. Ability and Inability to Meet Trimester-Specific HBA1C Goals, Stratified by CGM Use

	CGM (n=82)	SMBG (n=78)	p-value
Average HbA1C across pregnancy (%)	6.5 ± 0.8	6.8 ± 0.9	0.0089
HbA1C in T1, (%)	6.7 ± 1.1	7.1 ± 1.1	0.0127
HbA1C in T2, (%)	6.0 ± 0.8	6.3 ± 0.7	0.0274
HbA1C in T3, (%)	6.2 ± 0.7	6.5 ± 0.8	0.0082
Met HbA1c Goal T1 (≤6.5%), n (%)*	41 (50.0%)	23 (29.9%)	0.0093
Met HbA1c Goal T2 (≤6%), n (%)*	45 (55.6%)	26 (33.3%)	0.0046
Met HbA1c Goal T3 (≤6%), n (%)*	39 (50.0%)	18 (23.7%)	0.0006
Never Met HbA1c Goal in Any Trimester, n (%)	25 (32.5%)	44 (58.7%)	0.004

Data are presented as mean ± standard deviation or n (%).
Abbreviations: CGM, continuous glucose monitoring; HbA1C, hemoglobin A1C; SMBG, self-monitoring of blood glucose, T1, first trimester; T2, second trimester; T3, third trimester; TAR, time above range; TBR, time below range; TIR, time in range.
***Data missing for 1 and 4 in CGM group for T2 and T3, respectively. Data missing for 1 and 2 in SMBG group for T1 and T3, respectively.**

Table 3. Maternal and Neonatal Outcomes

Outcomes	CGM (n=82)	SMBG (n=78)	p-value
Maternal Outcomes			
Gestational weight gain (kg)	35.9 ± 16.0	31.8 ± 14.4	0.0971
Pregnancy-induced hypertension, n (%)	20 (24.4)	15 (19.2)	0.4301
Preeclampsia, n (%)*	33 (40.2)	19 (24.7)	0.0365^
Gestational age at delivery (weeks)	36.9 ± 2.2	36.9 ± 1.5	0.9571
Neonatal Outcomes			
Birth weight (grams)	3,315 ± 679	3, 568 ± 1.5	0.9571
Gestational Size by Percentile (%)	69.1 ± 31.7	83.0 ± 26.4	0.0030
Gestational Size for Age			
Small-for-Gestational-Age	4 (5.1)	4 (4.9)	0.9421
Appropriate-for-Gestational-Age	44 (53.7)	26 (33.3)	0.0096
Large-for-Gestational-Age	34 (41.5)	48 (61.5)	0.0111
NICU admission, n (%)*	43 (58.9)	39 (60)	0.8959
Duration of NICU stay (days)	11.8 ± 17.5	10.6 ± 11.8	0.7378

Data are presented as mean ± standard deviation or n (%).
Abbreviations: CGM, continuous glucose monitoring; HbA1C, hemoglobin A1C; NICU, neonatal intensive care unit; SMBG, self-monitoring of blood glucose.
***Data missing for 7 and 2 in CGM group and SMBG, respectively for gestational weight gain; for 1 in SMBG group for preeclampsia; for 9 and 13 in CGM group and SMBG group, respectively for NICU admission.**
^ P <0.05 after adjustment for BMI and HbA1C at first pregnancy visit.

CONCLUSIONS

- CGM users had a significantly higher rate of commercial insurance use (Table 1), while other baseline characteristics were similar between groups (p=0.0055).
- CGM users were more likely to meet HbA1C goals in all trimesters (p<0.01 for all; Table 2).
- More than half of SMBG users did not meet HbA1C goals in any trimester (58.7% SMBG vs 32.5% CGM, p=0.004; Table 2).
- CGM users had infants with lower mean birth weights (3,315 grams CGM vs 3,568 grams SMBG, p=0.0215; and 69.1% CGM vs 83.0% SMBG, p=0.0030).
- CGM users had lower rates of LGA infants(41.5% CGM vs 61.5% SMBG, p=0.011, Table 3).
- CGM users had higher rates of preeclampsia (40.2% CGM vs 24.7% SMBG, p=0.0365, Table 3).
  - While unexpected, PE pathogenesis is multifactorial with other relevant key players besides glycemic control[8].
- In summary, CGM users had lower rates of LGA infants and infants with lower mean birth weights, as well as a significantly increased likelihood of meeting trimester-specific HbA1c goals in each trimester throughout pregnancy in this real-world study.

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