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Original Article

Continuous Glucose Monitoring in Type 2 Diabetes Management

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Abstract-

Background: Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance and progressive β-cell dysfunction. Effective glycemic control is essential to prevent microvascular and macrovascular complications. Continuous glucose monitoring (CGM) has emerged as an innovative technology that provides real-time glucose measurements and trends, enabling improved diabetes management. ***Objective***: To evaluate the effectiveness of continuous glucose monitoring in improving glycemic control among patients with Type 2 diabetes mellitus. ***Materials and Methods***: A prospective observational study was conducted among 100 adults with T2DM attending a tertiary care diabetes clinic. Participants used CGM devices for 12 weeks in addition to standard diabetes care. Baseline and post-intervention parameters including glycated hemoglobin (HbA1c), fasting blood glucose (FBG), time in range (TIR), and incidence of hypoglycemia were assessed. Data were analyzed using descriptive and inferential statistics. ***Results***: Mean HbA1c decreased from 8.5 ± 1.2% at baseline to 7.6 ± 1.0% after 12 weeks. Mean fasting blood glucose reduced from 168 ± 35 mg/dL to 138 ± 28 mg/dL. Time in range improved from 52% to 71%, while hypoglycemic episodes decreased significantly. Participants reported improved treatment satisfaction and adherence. ***Conclusion***: Continuous glucose monitoring significantly improved glycemic control, increased time in target glucose range, and reduced hypoglycemic events among patients with T2DM. CGM may serve as an effective adjunct to conventional diabetes management strategies.

Keywords: *Type 2 diabetes mellitus, continuous glucose monitoring, HbA1c, glycemic control, time in range.*

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the most prevalent chronic diseases worldwide and represents a major public health challenge. According to the International Diabetes Federation, approximately 537 million adults were living with diabetes globally in 2021, with projections suggesting this number will rise to 643 million by 2030 and 783 million by 2045 (1). The increasing prevalence of T2DM is attributed to aging populations, urbanization, sedentary lifestyles, obesity, and unhealthy dietary habits.

Persistent hyperglycemia in T2DM is associated with the development of microvascular complications such as retinopathy, nephropathy, and neuropathy, as well as macrovascular complications including coronary artery disease, stroke, and peripheral vascular disease (2). Effective glycemic management remains the cornerstone of diabetes care, aiming to reduce complications and improve quality of life. Glycated hemoglobin (HbA1c) has traditionally been used as the primary marker of long-term glycemic control. However, HbA1c provides only an average measure of glucose levels over approximately three months and fails to capture daily glucose fluctuations and episodes of hypoglycemia or hyperglycemia (3).

Self-monitoring of blood glucose (SMBG) has been widely utilized to complement HbA1c measurements. While SMBG offers point-in-time glucose readings, it requires multiple finger-stick tests and may not adequately reflect glucose variability throughout the day. Consequently, many significant glucose excursions remain undetected (4).

Continuous glucose monitoring (CGM) technology has revolutionized diabetes management by providing real-time measurements of interstitial glucose concentrations throughout the day and night. CGM systems use a subcutaneous sensor that measures glucose levels at frequent intervals, typically every 1–5 minutes, allowing patients and healthcare providers to assess glucose trends, variability, and responses to meals, exercise, and medications (5).

Recent advances in CGM technology have improved accuracy, usability, and affordability, leading to increased adoption among individuals with diabetes. Studies have demonstrated that CGM use can improve glycemic outcomes, reduce HbA1c levels, increase time spent within target glucose ranges, and decrease the risk of hypoglycemia (6,7). Furthermore, CGM facilitates personalized treatment adjustments and empowers patients to actively participate in self-management.

Professional organizations such as the American Diabetes Association now recommend CGM for many individuals with diabetes, including selected patients with T2DM receiving insulin therapy (8). Despite growing evidence supporting its effectiveness, challenges remain regarding accessibility, cost, patient education, and long-term adherence.

The present study was undertaken to evaluate the impact of continuous glucose monitoring on glycemic control among patients with Type 2 diabetes mellitus and to assess its role in optimizing diabetes management.

MATERIALS AND METHODS

A prospective observational study was conducted over a period of 12 weeks in the Department of Endocrinology at a tertiary care teaching hospital.

Study Population

The study included adult patients diagnosed with Type 2 diabetes mellitus according to American Diabetes Association criteria.

Inclusion Criteria

1. Adults aged 30–70 years.
2. Diagnosed with T2DM for at least one year.
3. HbA1c between 7% and 11%.
4. Willingness to use CGM devices and provide informed consent.

Exclusion Criteria

1. Type 1 diabetes mellitus.
2. Pregnancy or gestational diabetes.
3. Severe renal or hepatic impairment.
4. Active infections or acute illness.
5. Inability to comply with study procedures.

Sample Size

A total of 100 participants meeting the eligibility criteria were enrolled through convenience sampling.

Ethical Considerations

Institutional Ethics Committee approval was obtained prior to commencement of the study. Written informed consent was obtained from all participants. Confidentiality and anonymity were maintained throughout the study.

Study Procedure

At baseline, demographic and clinical data including age, sex, duration of diabetes, body mass index (BMI), treatment regimen, fasting blood glucose, and HbA1c were recorded.
Participants were provided with a CGM device and trained regarding:

- Sensor insertion and maintenance.
- Interpretation of glucose trends.
- Recognition of hypo- and hyperglycemia.
- Lifestyle modifications and medication adherence.

The CGM device continuously recorded glucose levels over the study period. Participants attended follow-up visits at weeks 4, 8, and 12.

Outcome Measures

Primary Outcome

- Change in HbA1c from baseline to 12 weeks.

Secondary Outcomes

- Change in fasting blood glucose.
- Time in range (70–180 mg/dL).
- Frequency of hypoglycemic episodes (<70 mg/dL).
- Patient satisfaction with diabetes management.

Data Collection
Data were collected using structured case record forms and CGM reports generated by the monitoring system.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Paired t-tests were used to compare pre- and post-intervention values. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1. Baseline Characteristics of Participants (n = 100)

Variable	Value
Age (years)	56.3 ± 9.4
Male	58 (58%)
Female	42 (42%)
Duration of diabetes (years)	8.2 ± 4.6
BMI (kg/m²)	28.1 ± 3.7
Baseline HbA1c (%)	8.5 ± 1.2
Baseline FBG (mg/dL)	168 ± 35

The study population consisted predominantly of middle-aged adults with long-standing diabetes and suboptimal glycemic control at baseline.

Table 2. Comparison of Glycemic Parameters Before and After CGM Use

Parameter	Baseline	12 Weeks	p-value
HbA1c (%)	8.5 ± 1.2	7.6 ± 1.0	<0.001
FBG (mg/dL)	168 ± 35	138 ± 28	<0.001
Time in Range (%)	52 ± 12	71 ± 10	<0.001

Significant improvements were observed in HbA1c, fasting blood glucose, and time in range after 12 weeks of CGM use.

Table 3. Hypoglycemic Episodes Before and After CGM

Variable	Baseline	12 Weeks
Mean episodes/month	4.2 ± 1.8	1.5 ± 0.9
Severe episodes	8	2

The frequency of hypoglycemic episodes decreased substantially following implementation of CGM-guided management.

Table 4. Patient Satisfaction Scores

Satisfaction Level	Number (%)
Highly Satisfied	48 (48%)
Satisfied	38 (38%)
Neutral	10 (10%)
Dissatisfied	4 (4%)

Most participants reported positive experiences with CGM and expressed satisfaction with glucose monitoring and treatment adjustments.

DISCUSSION

Continuous glucose monitoring has transformed diabetes care by enabling comprehensive assessment of glucose patterns and facilitating timely therapeutic interventions. The present study demonstrated significant improvements in glycemic control among patients with T2DM following 12 weeks of CGM use.

A substantial reduction in HbA1c was observed from 8.5% to 7.6%. Similar findings were reported by Beck et al., who demonstrated that CGM use resulted in clinically meaningful reductions in HbA1c among adults with diabetes receiving insulin therapy (9). Improved HbA1c reflects better overall glucose management and is associated with reduced risk of long-term complications.

The study also showed a significant increase in time in range (TIR), rising from 52% to 71%. TIR has emerged as an important metric for assessing glycemic control beyond HbA1c because it captures daily glucose fluctuations and variability (10). Increased TIR is associated with lower risks of diabetic retinopathy, nephropathy, and cardiovascular complications.

Reduction in hypoglycemic episodes was another important finding. Hypoglycemia remains a major barrier to achieving optimal glycemic control and may result in serious adverse outcomes. CGM systems provide real-time alerts and trend information, allowing patients to take corrective actions before severe hypoglycemia develops (11). The reduction in hypoglycemic events observed in this study is consistent with previous reports demonstrating improved safety profiles among CGM users.

Patient satisfaction was notably high, with 86% reporting satisfaction or high satisfaction. Enhanced engagement in self-management and improved understanding of glucose patterns likely contributed to these positive perceptions. Studies have shown that CGM can improve diabetes-related quality of life and treatment confidence (12).

The findings align with recommendations from the American Diabetes Association, which advocates CGM use in appropriate patients with diabetes, particularly those using insulin therapy (8). Technological advancements have improved sensor accuracy and user convenience, making CGM increasingly accessible.

Despite these benefits, challenges remain. Cost and availability continue to limit widespread adoption, especially in low- and middle-income countries. Additionally, successful CGM implementation requires patient education and ongoing support from healthcare professionals (13).

The study has certain limitations. The observational design limits causal inference, and the relatively short follow-up period may not capture long-term outcomes. Furthermore, data were obtained from a single center, which may affect generalizability. Future randomized controlled trials with larger populations and longer follow-up periods are needed to further establish the long-term effectiveness and cost-effectiveness of CGM in T2DM management.

Overall, the study findings support the growing body of evidence indicating that continuous glucose monitoring is a valuable tool for optimizing glycemic control and improving patient outcomes in Type 2 diabetes mellitus.

CONCLUSION

Continuous glucose monitoring significantly improved glycemic control among patients with Type 2 diabetes mellitus. The technology was associated with reductions in HbA1c and fasting blood glucose, increased time in target glucose range, and fewer hypoglycemic episodes. High levels of patient satisfaction further support its integration into routine diabetes care. CGM represents an effective and patient-centered approach for enhancing diabetes management and reducing the risk of complications.

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