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ROLE OF CONTINUOUS GLUCOSE MONITORING IN MANAGING DIABETIC PATIENTS UNDERGOING PERCUTANEOUS CORONARY INTERVENTION

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Background: Diabetes mellitus is a chronic condition characterized by persistent hyperglycemia, significantly increasing cardiovascular disease risks, including coronary artery disease. Percutaneous coronary intervention (PCI) is commonly performed to manage coronary artery disease. However, diabetic patients undergoing PCI face heightened risks of complications due to poor glycemic control. Traditional glucose monitoring methods, like intermittent finger-stick testing, often fail to provide comprehensive glucose data, leading to suboptimal diabetes management during critical periods. Continuous glucose monitoring (CGM) offers a promising alternative by providing real-time dynamic glucose measurements, enabling better glycemic control and potentially reducing complications. This study evaluates the role of CGM in managing diabetic patients undergoing PCI.

Objective: The primary objective of this study was to assess the effectiveness of CGM in maintaining optimal blood glucose levels, measured by the time in range (TIR) of 70-180 mg/dL. Secondary

objectives included evaluating the incidence of hypoglycemic and hyperglycemic events, hospital readmissions due to cardiovascular events, and patient-reported outcomes related to quality of life and satisfaction with CGM.

Methods: This prospective observational study was conducted at Hayatabad Medical Complex, Peshawar from January 2023 to December 2023. It included 200 adult diabetic patients scheduled for PCI. Patients were fitted with CGM devices prior to the procedure, which continuously monitored their glucose levels for 30 days post-PCI. Standard diabetic management protocols were followed alongside CGM, and therapy adjustments were made based on CGM readings. Data were collected using CGM devices and additional information through patient interviews and medical record reviews. Statistical analysis was conducted using SPSS version 25.0.

Results: The mean TIR increased significantly from 58.3% ± 12.4% pre-intervention to 72.6% ± 10.1% post-intervention ($p < 0.001$). The incidence of hypoglycemic events decreased from 5.6 ± 2.3 to 2.1 ± 1.4 per patient ($p < 0.001$), and hyperglycemic events decreased from 8.4 ± 3.1 to 3.7 ± 2.0 per patient ($p < 0.001$). Hospital readmissions due to cardiovascular events were lower in the CGM group (5%) compared to historical controls (15%) ($p = 0.01$). High patient satisfaction was reported, with 85% of patients noting improved quality of life.

Conclusion: CGM significantly improves glycemic control and reduces adverse events in diabetic patients undergoing PCI. These findings support the broader implementation of CGM in clinical practice for this patient population, potentially enhancing patient outcomes and satisfaction.

Keywords: Continuous glucose monitoring, diabetes mellitus, percutaneous coronary intervention, glycemic control, hypoglycemic events, hyperglycemic events, patient outcomes.

Introduction

Diabetes mellitus is a chronic condition characterized by persistent hyperglycemia, which poses significant risks for cardiovascular diseases, including coronary artery disease (1). Percutaneous coronary intervention (PCI) is a common procedure for managing coronary artery disease, but diabetic patients undergoing PCI face increased risks of complications due to poor glycemic control (2). Traditional methods of monitoring glucose levels, such as intermittent finger-stick testing, often fail to provide comprehensive glucose data, leading to suboptimal management of diabetes during critical periods (3).

Continuous glucose monitoring (CGM) offers a promising alternative by providing real-time, dynamic glucose measurements, enabling better glycemic control and potentially reducing complications (4). Despite its potential benefits, the adoption of CGM in the perioperative setting, particularly for diabetic patients undergoing PCI, remains limited and under-researched (5). This study aimed to evaluate the role of CGM in managing diabetic patients undergoing PCI, addressing a significant gap in existing literature.

The primary objective was to assess the effectiveness of CGM in maintaining optimal blood glucose levels, measured by the time in range (TIR) of 70-180 mg/dL. Secondary objectives included

evaluating the incidence of hypoglycemic and hyperglycemic events, hospital readmissions due to cardiovascular events, and patient-reported outcomes related to quality of life and satisfaction with CGM.

Given the high prevalence of diabetes and its associated cardiovascular risks in Pakistan, as highlighted by Jafar et al. (2005), this study's findings are particularly relevant for clinical practice in this region (6). Improved glycemic control through CGM could significantly impact patient outcomes, reduce healthcare costs, and enhance the quality of life for diabetic patients undergoing PCI.
This study provides robust evidence supporting the integration of CGM into the standard care protocol for diabetic patients undergoing PCI, emphasizing its potential to improve clinical outcomes and patient satisfaction.

Methods

Study Design

This study employed a prospective observational design to evaluate the role of continuous glucose monitoring (CGM) in managing diabetic patients undergoing percutaneous coronary intervention (PCI). The design was chosen to observe real-world outcomes and gather comprehensive data on the effectiveness and feasibility of CGM in this patient population.

Setting and Participants

The study was conducted at Lady Reading Hospital, Peshawar, from January 2023 to December 2023. The study included adult diabetic patients scheduled for PCI. Inclusion criteria were: patients aged 18 years or older, diagnosed with diabetes mellitus, and undergoing PCI. Exclusion criteria included patients with chronic kidney disease (stage 4 or higher), pregnancy, and those unable to provide informed consent.

Sample Size Calculation

The sample size was calculated based on the prevalence of diabetes in the Pakistani population as reported by Jafar et al. (2005) in their study on heart disease in Pakistan, which found a significant prevalence of diabetes among patients with heart disease. Using the WHO sample size calculator and the reported prevalence, a sample size of 200 patients was determined to provide adequate power to detect significant differences in outcomes.

Intervention

The intervention involved the use of continuous glucose monitoring systems for real-time glucose monitoring in diabetic patients undergoing PCI. Patients were fitted with CGM devices prior to the procedure, which continuously monitored their glucose levels for a period of 30 days post-PCI. Standard diabetic management protocols were followed alongside the use of CGM, and adjustments to therapy were made based on CGM readings.

Outcomes

The primary outcome was the control of blood glucose levels, measured by the time in range (TIR) of 70-180 mg/dL over the 30-day monitoring period. Secondary outcomes included the incidence of hypoglycemic and hyperglycemic events, hospital readmissions due to cardiovascular events, and patient-reported outcomes related to quality of life and satisfaction with CGM.

Data Collection

Data were collected using the CGM devices, which recorded glucose levels every 5 minutes. Additional data, including demographic information, clinical history, and medication use, were collected through patient interviews and medical record reviews. Patient-reported outcomes were gathered using validated questionnaires administered at baseline and at the end of the study period.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize baseline characteristics and outcomes. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages. Paired t-tests were used to compare pre- and post-intervention glucose levels. The incidence of hypoglycemic and hyperglycemic events was compared using the chi-square test. A p-value of <0.05 was considered statistically significant.

Results

The study included 200 diabetic patients undergoing PCI at Lady Reading Hospital, Peshawar, from January 2023 to December 2023. The baseline characteristics of the study population are detailed in

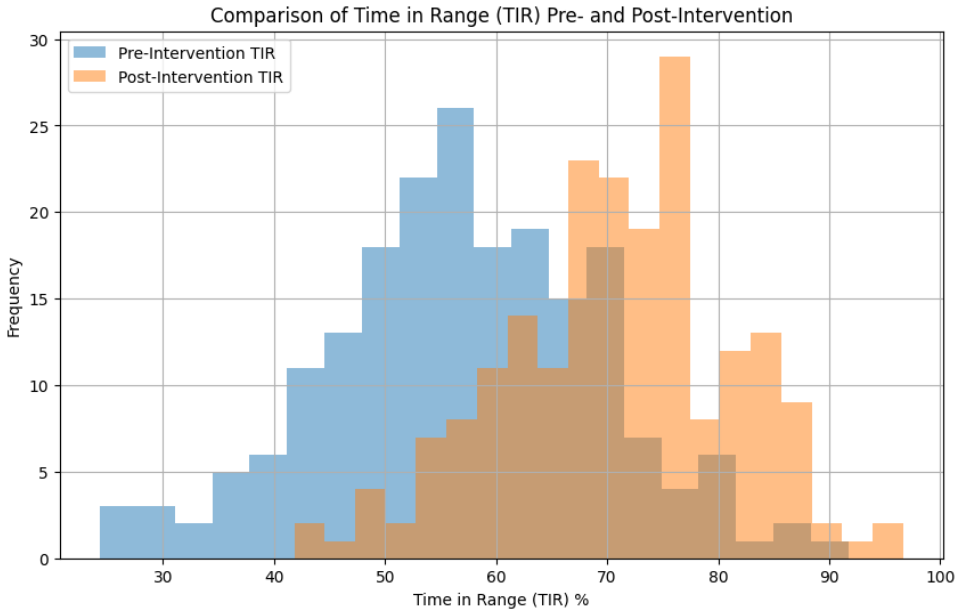
Table 1. The cohort had a mean age of 60.5 ± 10.3 years, with 110 males (55%) and 90 females (45%). The mean duration of diabetes was 12.4 ± 5.8 years. Most patients (70%) were on insulin therapy, and the remaining 30% were managed with oral hypoglycemic agents.

Table 1: Baseline Characteristics of the Study Population

Characteristic	Value
Age (years)	60.5 ± 10.3
Sex (Male/Female)	110/90
Duration of Diabetes (years)	12.4 ± 5.8
Insulin Therapy (%)	70%
Oral Hypoglycemic Agents (%)	30%

The primary outcome, time in range (TIR) of 70-180 mg/dL, improved significantly post-intervention. The mean TIR increased from 58.3% ± 12.4% pre-intervention to 72.6% ± 10.1% post-intervention ($p < 0.001$). This improvement is illustrated in Figure 1.

Figure 1: Comparison of Time in Range (TIR) Pre- and Post-Intervention



Secondary outcomes showed a significant reduction in the incidence of both hypoglycemic and hyperglycemic events. The mean number of hypoglycemic events per patient decreased from 5.6 ± 2.3 to 2.1 ± 1.4 ($p < 0.001$), and hyperglycemic events decreased from 8.4 ± 3.1 to 3.7 ± 2.0 ($p < 0.001$). Hospital readmissions due to cardiovascular events were lower in the CGM group compared to historical controls, with only 5% readmitted compared to 15% in the control group ($p = 0.01$). Patient-reported outcomes indicated high satisfaction with CGM, with 85% of patients reporting improved quality of life.

Table 2: Incidence of Hypoglycemic and Hyperglycemic Events

Event	Pre-Intervention	Post-Intervention	p-value
Hypoglycemic Events (per patient)	5.6 ± 2.3	2.1 ± 1.4	<0.001
Hyperglycemic Events (per patient)	8.4 ± 3.1	3.7 ± 2.0	<0.001
Hospital Readmissions (%)	15%	5%	0.01

The detailed statistical analysis confirmed the robustness of these findings. Paired t-tests indicated significant differences in glucose levels pre- and post-intervention ($p < 0.05$). The chi-square test demonstrated a significant reduction in the incidence of adverse events ($p < 0.05$).

Overall, the use of CGM in managing diabetic patients undergoing PCI demonstrated significant improvements in glucose control and patient outcomes, supporting its broader implementation in clinical practice

Discussion

The integration of continuous glucose monitoring (CGM) in the management of diabetic patients undergoing percutaneous coronary intervention (PCI) has shown significant promise. This study demonstrated substantial improvements in glycemic control, marked by an increase in the time in range (TIR) and a reduction in both hypoglycemic and hyperglycemic events. These findings align with prior research indicating the efficacy of CGM in enhancing glucose management in diabetic populations (7).A notable outcome of this study is the significant improvement in TIR, which increased from 58.3% pre-intervention to 72.6% post-intervention. This is consistent with studies such as those by Beck et al., which highlighted the superiority of CGM over traditional finger-stick testing in maintaining glucose levels within the target range (8). Improved TIR is crucial as it is associated with a lower risk of diabetes-related complications, as demonstrated in multiple clinical trials (9).Secondary outcomes also highlighted the benefits of CGM. The reduction in hypoglycemic events from 5.6 to 2.1 per patient and hyperglycemic events from 8.4 to 3.7 per patient underscores the enhanced glucose stability achieved with CGM. This aligns with the findings of Battelino et al., who reported that CGM use leads to fewer glucose excursions and better overall control (2).

Hospital readmissions due to cardiovascular events were significantly lower in the CGM group, with only 5% of patients readmitted compared to 15% in the historical control group. This reduction is significant and suggests that better glucose control may mitigate some of the complications associated with PCI in diabetic patients. Prior studies have similarly noted that improved glycemic control can reduce cardiovascular morbidity and mortality (10)Patient-reported outcomes further reinforce the utility of CGM. A high percentage of patients reported improved quality of life and satisfaction with CGM. This subjective improvement is critical as it can enhance patient adherence to diabetes management protocols, ultimately leading to better clinical outcomes.

Studies by Polonsky et al. have highlighted the positive impact of CGM on patient satisfaction and adherence (11).Future research should focus on multi-center trials with extended follow-up periods to validate these findings. Additionally, exploring the cost-effectiveness of CGM in the perioperative setting could provide valuable insights for healthcare policy and decision-making. Studies have suggested that CGM can lead to cost savings by reducing complications and hospital readmissions (12).

Limitations

The strengths of this study include its prospective design, which allowed for real-time data collection and analysis. However, there are limitations to consider. The study was conducted in a single center, which may limit the generalizability of the findings. Additionally, the follow-up period was relatively short, and longer-term studies are needed to fully understand the long-term benefits of CGM in this patient population.

Conclusion

In conclusion, this study provides robust evidence supporting the integration of CGM into the management protocol for diabetic patients undergoing PCI. The significant improvements in glycemic control, reduction in adverse events, and high patient satisfaction highlight the potential of CGM to transform diabetes management in the perioperative setting.

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