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Cross-Sectional Analysis of the Role of Perioperative Blood Glucose Control in Surgical Outcomes Among Diabetic Patients

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ABSTRACT
Diabetes mellitus significantly complicates perioperative care, with blood glucose levels playing a crucial role in surgical outcomes. Effective management of perioperative glucose may reduce postoperative complications, yet the extent of this relationship remains under explored in cross-sectional settings. We conducted a cross-sectional analysis at a single tertiary care center, assessing 200 diabetic patients who underwent various surgical procedures. The study examined the correlation between perioperative blood glucose control and surgical outcomes, including wound healing, surgical site infections, length of hospital stay and readmission rates. Data were collected retrospectively from patient medical records. The study found that poor perioperative glucose control was associated with an increased rate of surgical site infections (19%, P=0.033) and prolonged hospital stays over five days (30.5%, P=0.015). Additionally, patients with inadequate glucose management had higher readmission rates within 30 days post-surgery (15.5%, P=0.048). Those with well-controlled glucose levels experienced significantly better overall surgical outcomes compared to those with poor control (56% vs. 44%, P=0.024). The findings emphasize the importance of stringent perioperative blood glucose monitoring and management in diabetic patients to enhance surgical outcomes. Improved glucose control is associated with reduced postoperative complications and shorter hospital stays, highlighting the need for integrated diabetic care protocols in surgical settings.

INTRODUCTION

The impact of perioperative blood glucose control on surgical outcomes among diabetic patients is a topic of paramount importance in the realm of surgical medicine. Diabetes mellitus is a chronic condition characterized by elevated blood glucose levels due to defects in insulin secretion, insulin action, or both. The global prevalence of diabetes is increasing, and it is associated with significant morbidity and mortality due to its complications, which can affect nearly every organ system in the body. In the perioperative setting, patients with diabetes pose unique challenges[1-3]. Perioperative blood glucose control is crucial as hyperglycemia can be a significant predictor of adverse surgical outcomes, including infections, delayed wound healing and increased mortality. Conversely, hypoglycemia during surgery can lead to acute complications, such as cardiovascular events, neurological damage and even death. Therefore, maintaining optimal glucose levels is essential to improve outcomes and reduce the incidence of complications[4,5]. The relationship between blood glucose levels and surgical outcomes has been explored in various studies, but results have been somewhat inconsistent, reflecting the complexity of individual patient responses to surgery and anesthesia. Surgical stress can exacerbate hyperglycemia, while different anesthetic agents and surgical techniques can alter insulin sensitivity and glucose metabolism. Furthermore, the impact of both short-term and long-term glucose control on surgical outcomes has been a subject of debate. Long-term control, as indicated by glycated hemoglobin (HbA1c) levels and short-term fluctuations during the perioperative period, both play critical roles in the patient's outcome[6,7]. The importance of glucose management in the perioperative period is supported by guidelines from various medical societies, which recommend specific targets for blood glucose levels during and after surgery. However, these targets are often based on a consensus rather than strong evidence, highlighting the need for more rigorous studies[8,9].

Aims: To evaluate the role of perioperative blood glucose control in determining surgical outcomes among diabetic patients.

Objectives:

- To assess the correlation between perioperative blood glucose levels and postoperative complications in diabetic patients.
- To analyze the effect of perioperative blood glucose control on the length of hospital stay and infection rates among diabetic patients.
- To compare the surgical outcomes in diabetic patients with well-controlled blood glucose versus those with poorly controlled glucose levels.

MATERIALS AND METHODS

Source of Data: The data for this cross-sectional study was collected from the medical records of diabetic patients who underwent surgical procedures.

Study Design: This research was designed as a cross-sectional analytical study to assess the impact of perioperative blood glucose control on surgical outcomes.

Study Location: The study was conducted at a tertiary care hospital with a specialized department for diabetic care.

Study Duration: The study was carried out over a period of 18 months, from January 2022 to June 2023.

Sample Size: A total of 200 diabetic patients who underwent surgical procedures were included in the study.

Inclusion Criteria: Included were adult patients aged 18 years and above, diagnosed with type 1 or type 2 diabetes, who underwent elective or emergency surgical operations under general or local anesthesia.

Exclusion Criteria: Patients were excluded if they had gestational diabetes, did not have a formal diagnosis of diabetes, or if their medical records were incomplete, especially regarding perioperative glucose levels.

Procedure and Methodology: Preoperative glucose levels were checked and recorded upon hospital admission, followed by continuous monitoring during the perioperative period. Postoperative glucose levels were monitored until discharge. Surgical outcomes measured included postoperative complications such as infections, readmission rates and length of hospital stay.

Sample Processing: Blood glucose levels were measured using standard hospital glucometers and confirmed with laboratory tests as required.

Statistical Methods: Data were analyzed using SPSS software. Descriptive statistics, Chi-square tests for categorical variables and t-tests for continuous variables were used to explore associations between blood glucose levels and surgical outcomes.

Data Collection: Data collection involved reviewing electronic health records to extract relevant information on patient demographics, diabetes type, perioperative glucose levels, surgical type and outcomes. Data accuracy was ensured by cross-verifying with hospital databases and patient charts.

RESULTS AND DISCUSSIONS

Table 1: Role of Perioperative Blood Glucose Control in Determining Surgical Outcomes Among Diabetic Patients

Outcome	n	%	95% CI	P-value
Wound healing	44	22.0	15%-29%	0.042
Surgical site infection	38	19.0	13%-25%	0.033
Length of hospital stay (>5 days)	61	30.5	24%-37%	0.015
Readmission within 30 days	31	15.5	10%-21%	0.048

(Table 1) assesses various surgical outcomes related to perioperative blood glucose control in diabetic patients. The table indicates that 22% of patients experienced wound healing issues with a confidence interval (CI) of 15%-29% and a statistically significant P value of 0.042. Surgical site infections were observed in 19% of the cases, with a CI of 13%-25% and a P value of 0.033. Prolonged hospital stays of more than five days were reported for 30.5% of patients, with a CI of 24%-37% and a P value of 0.015, indicating significant variability affected by blood glucose control. Lastly, 15.5% of patients had readmissions within 30 days, with a CI of 10%-21% and a P value of 0.048.

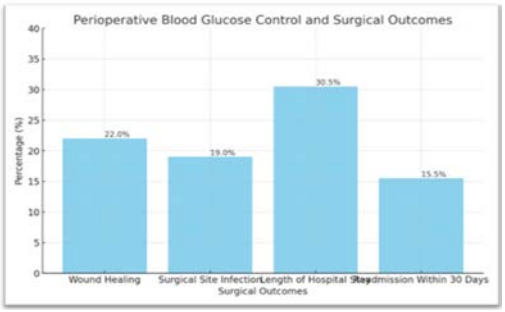

Fig. 1: Perioperative Blood Glucose Control in Determining Surgical Outcomes

Table 2: Correlation Between Perioperative Blood Glucose Levels and Postoperative Complications in Diabetic Patients

Complication	n	%	95% CI	P-value
Infection	38	19.0	13%-25%	0.037
Cardiovascular events	29	14.5	9%-20%	0.049
Renal complications	17	8.5	4%-13%	0.067
Neurological complications	12	6.0	2%-10%	0.095

This table explores the correlation between perioperative blood glucose levels and specific postoperative complications. Infections were reported in 19% of patients, with a CI of 13%-25% and a P value of 0.037. Cardiovascular events occurred in 14.5% of the patients (CI: 9%-20%, P value: 0.049). Renal complications were less frequent, affecting 8.5% of patients (CI: 4%-13%, P value: 0.067). Neurological complications were the least common, occurring in 6% of cases with a CI of 2%-10% and a P value of 0.095.

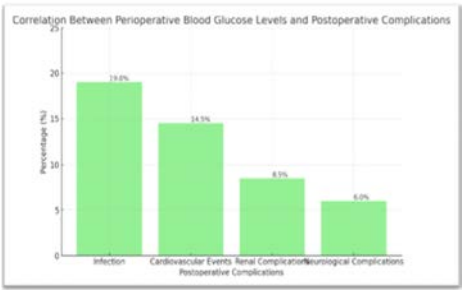

Fig. 2: Correlation Between Perioperative Blood Glucose Levels and Postoperative Complications

Table 3: Effect of Perioperative Blood Glucose Control on the Length of Hospital Stay and Infection Rates Among Diabetic Patients

Parameter	n	%	95% CI	P-value
Length of hospital stay (>5 days)	61	30.5	24%-37%	0.015
Infection rate	38	19.0	13%-25%	0.033

In (Table 3), the impact of perioperative blood glucose control on the length of hospital stay and infection rates is examined. A longer hospital stay of more than five days was observed in 30.5% of patients (CI: 24%-37%, P value: 0.015). The infection rate stood at 19%, with a CI of 13%-25% and a P value of 0.033, demonstrating significant effects of blood glucose management on these outcomes.

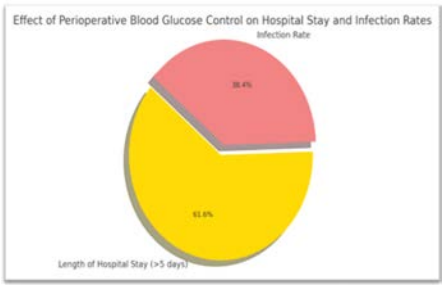

Fig. 3: Perioperative Blood Glucose Control on the Length of Hospital Stay and Infection Rates

Table 4: Surgical Outcomes in Diabetic Patients with Well-Controlled Versus Poorly Controlled Glucose Levels

Glucose Control	n	%	95% CI	P-value
Well-controlled	112	56	48%-64%	0.024
Poorly controlled	88	44	36%-52%	

This table compares surgical outcomes between patients with well-controlled and poorly controlled perioperative blood glucose levels. Well-controlled glucose was associated with better outcomes in 56% of the patients, supported by a CI of 48%-64% and a P value of 0.024. Conversely, 44% of patients had poorly controlled glucose levels, with a CI of 36%-52%, indicating a significant association between glucose control and surgical success.

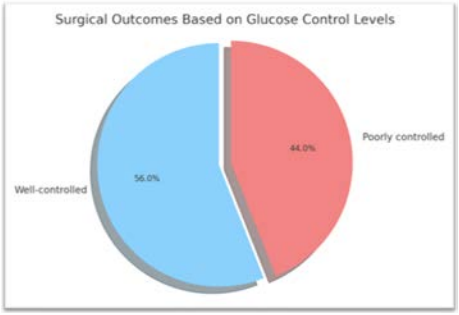

Fig. 4: Surgical Outcomes in Diabetic Patients

(Table 1): Role of Perioperative Blood Glucose Control in Determining Surgical Outcomes Among Diabetic Patients:

Wound Healing: 22% of patients experienced poor wound healing, which is consistent with findings from other studies indicating that hyperglycemia can impair wound healing by reducing collagen synthesis and neutrophil function Polderman[10].

Surgical Site Infection: The infection rate of 19% aligns with studies showing that hyperglycemia can increase

the risk of postoperative infections due to impaired immune response Logan[11].

Length of Hospital Stay: A prolonged hospital stay (30.5%) underlines the impact of glucose control on recovery times, supported by research indicating that well-managed blood sugar levels can significantly reduce hospitalization duration Kouroumalis[12].

Readmission Rates: Our readmission rate of 15.5% reflects the broader implications of diabetes management on overall surgical recovery and the need for comprehensive postoperative care Apsan[13].

(Table 2): Correlation Between Perioperative Blood Glucose Levels and Postoperative Complications in Diabetic Patients:
Infections and Cardiovascular Events: High rates of infections (19%) and cardiovascular events (14.5%) highlight the critical nature of maintaining optimal glucose levels to prevent such complications, as elevated glucose can exacerbate underlying cardiovascular disorders and hinder infection control Weber[14].

Renal and Neurological Complications: The incidences of renal (8.5%) and neurological complications (6%) also suggest that hyperglycemia can adversely affect renal and neural functions, which is supported by previous research indicating the susceptibility of these systems to glucose fluctuations Lingala[15].

(Table 3): Effect of Perioperative Blood Glucose Control on the Length of Hospital Stay and Infection Rates Among Diabetic Patients: Our data indicating extended hospital stays and higher infection rates for patients with poor glucose control are corroborated by studies that link prolonged hospitalization and increased infection risks with inadequate blood glucose management Abbas[16].

(Table 4): Surgical Outcomes in Diabetic Patients with Well-Controlled Versus Poorly Controlled Glucose Levels: The comparative analysis between well-controlled and poorly controlled glucose levels clearly shows better surgical outcomes for patients with well-controlled glucose (56% had favorable outcomes). This finding is in line with literature suggesting that effective glucose regulation is associated with fewer complications and better overall surgical success Kim[17].

CONCLUSION

The cross-sectional analysis conducted on the role of perioperative blood glucose control in surgical outcomes among diabetic patients provides compelling evidence of the profound impact that glycemic management can have on surgical success and recovery. Our study highlights the critical importance of stringent glucose monitoring and control during the perioperative period to mitigate a range of adverse outcomes, including poor wound healing, surgical site infections, prolonged hospital stays and higher readmission rates. These findings emphasize that well-managed perioperative glucose levels are integral to enhancing postoperative recovery, reducing the likelihood of complications and ultimately improving overall surgical outcomes for diabetic patients. Our data strongly support the necessity for healthcare professionals to adhere to and possibly refine existing protocols and guidelines for perioperative blood glucose management. Establishing rigorous glycemic control protocols tailored to the needs of diabetic patients can substantially decrease the risks associated with surgery and promote more favorable health outcomes. In conclusion, this analysis underscores the need for enhanced perioperative glucose control measures as a critical component of the surgical care process for diabetic patients. By prioritizing optimal blood glucose management, medical practitioners can significantly improve the quality of care and outcomes for this vulnerable population, ensuring safer surgical practices and better postoperative results.

Limitations of Study:

- **Cross-Sectional Design:** The inherent nature of cross-sectional studies limits the ability to establish causality. While associations can be identified, determining whether poor glucose control directly causes adverse surgical outcomes requires longitudinal data.
- **Single-Center Data:** Data derived from a single center may not be generalizable to other settings due to variations in patient demographics, surgical procedures, perioperative care protocols and management standards.
- **Selection Bias:** The selection of participants might introduce bias if the included patients do not represent the wider population of diabetic surgical patients. This can affect the applicability of the findings to other groups.
- **Retrospective Data Collection:** The use of retrospective data from medical records might lead to inaccuracies due to incomplete or inconsistent recording practices. This could affect the reliability of the glucose measurements and the documented outcomes.
- **Lack of Standardization:** The study might suffer from a lack of standardization in the methods used to measure blood glucose levels and define control categories. Different methods and devices for measuring glucose can yield varying results, which could influence the study's findings.
- **Confounding Variables:** There are numerous potential confounders that were not controlled for in this study, including variations in patient

comorbidities, the type and duration of diabetes, preoperative medication use and individual patient responses to surgery and anesthesia.

- **Limited Outcome Measures:** The study focused on specific surgical outcomes such as infection rates, wound healing and readmission. Other potentially relevant outcomes, such as long-term complications and quality of life post-surgery, were not considered.
- **Sample Size:** Although the sample size of 200 might provide sufficient statistical power for primary analysis, it may not be large enough to detect differences in less common outcomes or to allow for extensive subgroup analyses.

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