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Original Research Article

Effect of Preoperative Glycemic Management on Surgical Site Infections among Diabetic Patients

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Abstract:

Background and Aim: Surgical site infections (SSI) are a major postoperative complication in diabetic patients, with hyperglycemia recognized as a significant risk factor. This study aimed to evaluate the impact of preoperative glycemic control on postoperative wound infections in diabetic patients.

Methods: A hospital-based prospective study was conducted over one year in a tertiary care hospital, enrolling 184 diabetic patients undergoing general surgery. Preoperative fasting blood glucose and HbA1c levels were recorded, and patients were followed postoperatively for wound infections and other complications. Patients were categorized based on glycemic control as good, fair, or poor. Data were analyzed to assess the association between glycemic status and postoperative outcomes.

Results: The study included predominantly female patients (67.4%) with the most common age group being 51–60 years (26.1%). Overall, 50% of patients developed SSI, with the highest incidence in the poor glycemic control group (67.6%). Postoperative blood glucose levels on days 1, 3, and 7 were significantly higher in patients with SSI ($p < 0.05$). Other complications, including delayed wound healing and urinary tract infections, were also more frequent in patients with suboptimal glycemic control.

Conclusion: Poor preoperative glycemic control is associated with higher rates of surgical site infections and postoperative complications in diabetic patients. Optimizing blood glucose before surgery may reduce morbidity and improve outcomes.

Keywords: Preoperative Glycemic Control, Diabetic Patients, Surgical Site Infection, Postoperative Complications.

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Introduction

Preoperative hyperglycemia is a well-recognized and potentially modifiable risk factor for adverse surgical outcomes, particularly surgical site infections (SSI), which remain among the most common postoperative complications. Diabetic patients are especially vulnerable, as elevated preoperative blood glucose levels are positively associated with higher SSI rates and poorer postoperative outcomes compared with non-diabetic surgical patients [1]. Hyperglycemia prior to surgery adversely affects host immune defenses, notably polymorphonuclear leukocyte function, leading to impaired granulocyte adherence, reduced phagocytosis, delayed chemotaxis, and diminished bactericidal activity, changes that can occur at glucose levels as low as 200 mg/dL [2]. These immune dysfunctions contribute to delayed wound healing and increased susceptibility to infection, underscoring the importance of adequate glycemic control before surgical intervention.

Emerging evidence suggests that poor preoperative glycemic control is a major contributor to postoperative infections, and improved glucose management before surgery may reduce SSI rates in surgical patients [3]. Although intensive glycemic control has been shown to reduce infectious complications, concerns remain regarding hypoglycemia, particularly with aggressive insulin therapy, and the lack of clarity regarding optimal glucose targets in diabetic patients undergoing surgery [3-5]. Large clinical trials and observational studies, including the Leuven 1 study, have demonstrated reductions in complications and mortality with glucose control in general surgical populations; however, subgroup analyses in diabetic patients have produced inconsistent results [4]. These discrepancies highlight the need for targeted evaluation of preoperative glycemic control specifically in diabetic individuals.

Current clinical guidelines emphasize the importance of maintaining controlled blood glucose levels before surgery, yet recommended targets vary among professional bodies and definitive evidence supporting an optimal preoperative range in diabetic patients is lacking [5]. Elevated glucose levels prior to surgery have been associated with increased risks of infection, thrombotic events, myocardial infarction, stroke, delayed wound healing, and mortality [6-10]. Despite significant advancements in surgical techniques, antimicrobial prophylaxis, and perioperative care, SSIs continue to pose substantial clinical and economic burdens, adversely affecting patient recovery, quality of life, and healthcare costs [11-13]. In this context, examining the impact of preoperative glycemic control on postoperative wound infection in diabetic patients is essential to guide evidence-based surgical care and improve outcomes.

Accordingly, the present study aims to assess the effect of preoperative glycemic control on the occurrence of postoperative wound infections in diabetic patients. It seeks to examine the association between preoperative blood glucose levels and surgical site infection rates, thereby contributing evidence toward optimizing preoperative glucose management in this population.

Materials and Methods

Study Setting: This investigation was carried out at a tertiary care hospital over a duration of one year. The study was designed as a hospital-based prospective analysis involving patients undergoing general surgical procedures.

Sample Size: A total of 184 patients with a confirmed diagnosis of diabetes mellitus who were scheduled for general surgery were enrolled in the study.

Inclusion Criteria

- Patients with a confirmed diagnosis of diabetes mellitus (Type 1 or Type 2).
- Patients aged 18 years and above.
- Patients undergoing elective or emergency general surgical procedures.
- Patients with documented preoperative blood glucose and HbA1c values.
- Patients who provided informed consent to participate in the study.

Exclusion Criteria

- Patients without a diagnosis of diabetes mellitus.
- Patients with major comorbid conditions likely to influence wound healing or infection risk (e.g., advanced renal failure, chronic liver disease, immunosuppressive disorders, malignancy).
- Patients receiving long-term immunosuppressive therapy or corticosteroids.
- Patients presenting with established infections or sepsis prior to surgery.
- Patients who developed postoperative infections within 36 hours of surgery, to exclude early procedure-related or pre-existing infections.

Data Collection and Analysis: Relevant clinical and laboratory data were collected using a structured proforma. Preoperative glycemic parameters, including blood glucose levels and HbA1c, along with hematological and microbiological investigations, were recorded. Patients were monitored postoperatively for evidence of wound infection and other infectious complications. Data were analyzed to assess the association between preoperative glycemic control and postoperative wound infection outcomes.

Results

The study population consisted of 184 diabetic patients undergoing general surgical procedures, with a majority aged between 51–60 years (26.1%), followed by the 31–40 (20.7%) and 41–50 years (19.6%) age groups, while patients aged 61–70 and 71–80 years each accounted for 16.8% of the sample. Females predominated, comprising 67.4% of the participants, whereas males accounted for 32.6%. Regarding preoperative glycemic control, 20.7% of patients had good control, 42.4% had fair control, and 37.0% exhibited poor control, indicating that a substantial proportion of the study population had suboptimal glucose management prior to surgery (Table 1).

Among the 184 diabetic patients included in the study, inguinal hernioplasty was the most commonly performed surgical procedure (23.9%), followed by ventral hernioplasty (20.7%) and thyroidectomy (14.1%). Laparoscopic cholecystectomy and Jaboulay's procedure accounted for 11.4% and 12.0% of cases, respectively. Benign lesion excisions (9.8%) and mastectomies (8.2%) constituted a smaller proportion of the surgical interventions, reflecting a varied spectrum of general surgical procedures in the study population.

Patients who developed surgical site infections exhibited consistently higher blood glucose levels compared to those without SSI. While preoperative fasting blood sugar and HbA1c levels were higher in the SSI group, these differences did not reach statistical significance. In contrast, postoperative blood glucose levels on days 1, 3, and 7 were significantly elevated among patients with SSI, indicating a strong association between sustained postoperative hyperglycemia and the development of wound infection. These findings suggest that although preoperative glycemic status contributes to

risk stratification, poor postoperative glucose control plays a critical role in the occurrence of surgical site infections in diabetic patients (Table 2).

Table 1: Demographic Characteristics and Glycemic Control of Study Participants (n = 184)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	31–40	38	20.7
	41–50	36	19.6
	51–60	48	26.1
	61–70	31	16.8
	71–80	31	16.8
Sex	Female	124	67.4
	Male	60	32.6
Glycemic Control	Good Control	38	20.7
	Fair Control	78	42.4
	Poor Control	68	37.0
	Total	**184**	**100.0**

Table 2: Comparison Between Surgical Site Infection and Blood Glucose Parameters (n = 184)

Blood Glucose Parameters	No SSI (n = 92) Mean ± SD	SSI Present (n = 92) Mean ± SD	P value
Fasting Blood Sugar (mg/dL)	165.2 ± 18.6	176.8 ± 20.4	0.061
HbA1c (%)	7.48 ± 0.86	8.02 ± 0.98	0.058
Post-operative Day 1 Sugar (mg/dL)	201.6 ± 20.2	215.9 ± 17.4	**0.009**
Post-operative Day 3 Sugar (mg/dL)	205.3 ± 22.8	218.6 ± 18.9	**0.028**
Post-operative Day 7 Sugar (mg/dL)	204.7 ± 21.9	217.8 ± 19.2	**0.026**

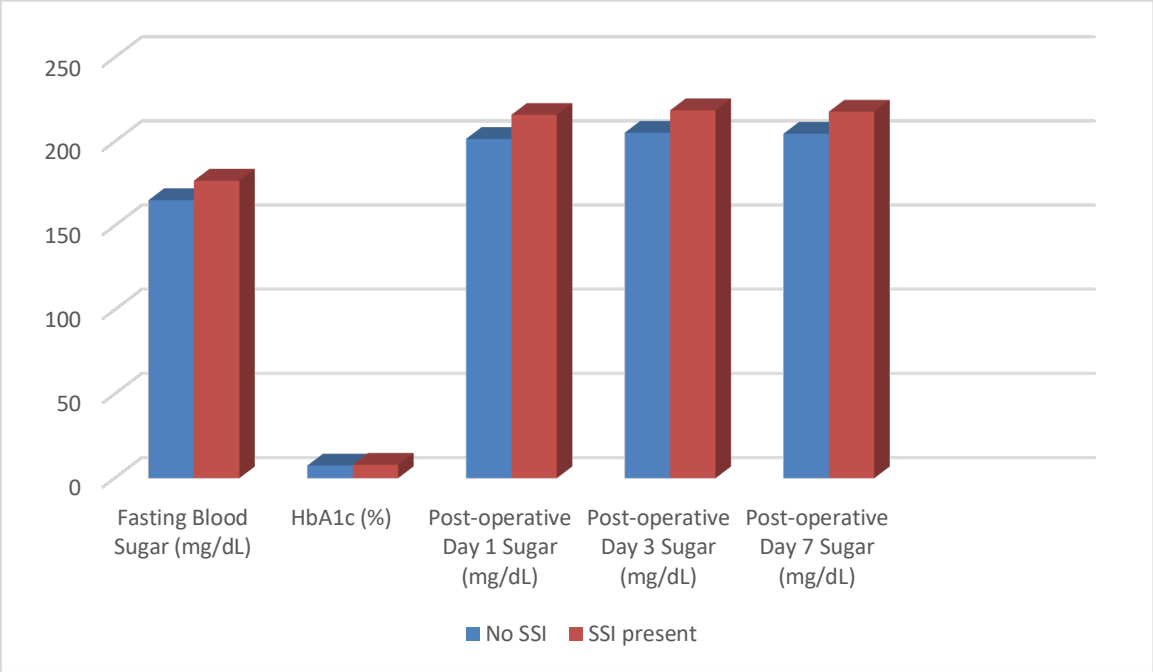

Figure 1: Comparison Between Surgical Site Infection and Blood Glucose Parameters.

Postoperative complications showed a clear association with preoperative glycemic control. Surgical site infection was the most frequent complication, occurring in 50.0% of patients overall, with the highest incidence observed among those with poor glycemic control (67.6%), compared to fair (43.6%) and good control groups (31.6%). Delayed wound healing, urinary tract infections, fever, and the need for reoperation were also progressively more common as glycemic control worsened. Conversely, patients with good preoperative glycemic control demonstrated the lowest complication rates and the highest proportion of uneventful recoveries, indicating that optimal glucose control prior to surgery is associated with reduced postoperative morbidity in diabetic patients (Table 3).

Table 3: Association Between Preoperative Glycemic Control and Postoperative Complications (n = 184)

Preoperative Glycemic Control	Total (n)	Surgical Site Infection n (%)	Delayed Wound Healing n (%)	Urinary Tract Infection n (%)	Fever n (%)	Reoperation n (%)	No Complications n (%)
Good Control	38	12 (31.6)	8 (21.1)	5 (13.2)	3 (7.9)	2 (5.3)	21 (55.3)
Fair Control	78	34 (43.6)	26 (33.3)	17 (21.8)	7 (9.0)	8 (10.3)	32 (41.0)
Poor Control	68	46 (67.6)	32 (47.1)	21 (30.9)	10 (14.7)	14 (20.6)	19 (27.9)
Total	**184**	**92 (50.0)**	**66 (35.9)**	**43 (23.4)**	**20(10.9)**	**24 (13.0)**	**72 (39.1)**

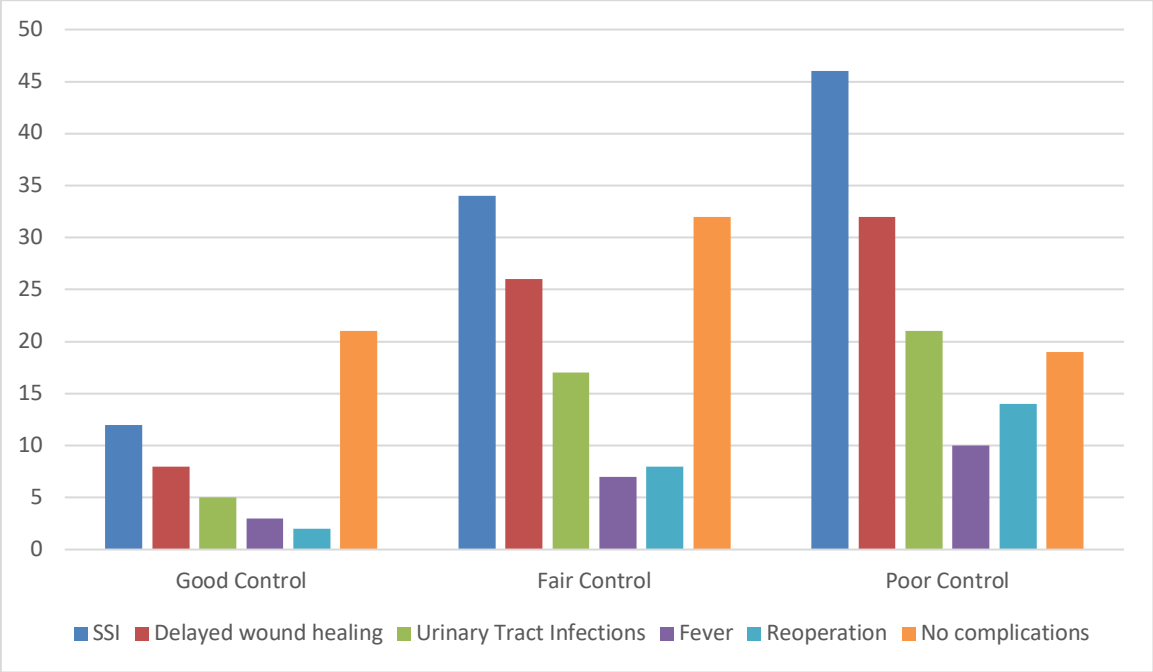

Figure 2: Postoperative Complications by Preoperative Glycemic Control.

Discussion

In this study of 184 diabetic patients undergoing general surgical procedures, the majority were female (67.4%), with the most common age group being 51-60 years (26.1%), followed by 31-40 years (20.7%). These demographic findings are consistent with previous perioperative studies that report higher female representation in elective surgeries and increased surgical interventions among older adults, who are also at higher risk for complications and impaired glycemic control. The trends observed suggest that age and sex remain important factors in evaluating perioperative risk and planning preoperative management strategies [14].

The overall incidence of postoperative surgical site infections (SSIs) in the cohort was 50.0%, with a marked increase among patients with poor preoperative glycemic control (67.6%) compared to those with fair (43.6%) and good control (31.6%). These findings align with Kwon et al. [15], who demonstrated that perioperative hyperglycemia more than doubles the risk of infections in general surgery patients. While fasting blood glucose and HbA1c were higher in the SSI group (176.8 mg/dL and 8.02%, respectively) than in patients without SSI (165.2 mg/dL and 7.48%), these differences did not reach statistical significance ($p = 0.061$ and 0.058, respectively). However, postoperative blood glucose levels on days 1, 3, and 7 were significantly elevated in patients with SSI ($p < 0.05$), highlighting the critical role of sustained glycemic control in reducing the risk of postoperative infections. These results suggest that preoperative optimization combined with careful postoperative monitoring is essential for minimizing SSIs [4, 15, 16].

Analysis of additional postoperative complications, including delayed wound healing, urinary tract infection, fever, and reoperation, revealed a clear association with suboptimal glycemic control. Patients with poor preoperative glucose control experienced higher rates of delayed wound healing (47.1%), UTIs (30.9%), fever (14.7%), and reoperation (20.6%) compared to those with fair or good control. These findings are in agreement with prior studies by Kwon et al. [15] and Berhe et al. [16], which report that hyperglycemia, even in non-

diabetic patients, is linked to increased postoperative morbidity, including infections, delayed recovery, and prolonged hospital stay. The data underscore the need to maintain blood glucose within an optimal range to balance the benefits of glycemic control while avoiding hypoglycemia, as overly strict control can lead to adverse outcomes [16, 6].

The cohort demonstrated suboptimal long-term glycemic control, with an average HbA1c of 7.806% (SD 0.946), and 80% of patients had HbA1c levels greater than 7%. Patients with preoperative blood glucose in the 120–180 mg/dL range had an average HbA1c of 7.19%, while those in the 181-220 mg/dL range had a higher mean HbA1c of 8.80%, though the difference was not statistically significant ($p = 0.926$). These findings suggest that while short-term blood glucose contributes to immediate surgical risk, long-term glycemic status may also impair immune function, leukocyte activity, and wound healing, increasing susceptibility to complications [4,15,16]. The observed postoperative hyperglycemia, reflecting the physiological stress response to surgery, further emphasizes the importance of both preoperative optimization and tight perioperative glucose monitoring to improve surgical outcomes and reduce morbidity [4, 16, 6].

Conclusion

The study demonstrates that poor preoperative glycemic control in diabetic patients is strongly associated with an increased risk of surgical site infections and other postoperative complications, including delayed wound healing, urinary tract infections, and the need for reoperation. Patients with optimal preoperative glucose levels experienced fewer complications and higher rates of uneventful recovery, highlighting the critical role of preoperative glycemic optimization in improving surgical outcomes. These findings underscore the importance of careful assessment and management of blood glucose levels before surgery, as well as vigilant postoperative monitoring, to minimize morbidity and enhance recovery in diabetic surgical patients.

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