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IMPACT OF PREOPERATIVE GLYCEMIC CONTROL ON POSTOPERATIVE WOUND HEALING IN ELECTIVE SURGICAL PATIENTS

Qurat Ul Ain[1], Kashaf Fatima[2], Umer Iftikhar[*3], Mehak Fatima[4], Samman Sajjad[5], Muhammad Kamran Anwar[6]

[1]MBBS, Women Medical Officer, BHU Pothimakwalan Rawalakot Poonch AJK
[2]MBBS, Emergency Medicine SHO, Shaikh Zayed Hospital, Lahore
[*3,4]*MBBS (RMP) Shaikh Zayed Hospital, Lahore,*
[5]*MBBS, Medical Officer, Shaikh Zayed Hospital, Lahore*
[6]*MBBS, Currently Doing Internship at Department of Paediatrics Shaikh Zayed Hospital Lahore*

quratulainsaeed.77@gmail.com[1], kf67548@gmail.com[2], [*3]umeriftikhar.ch@gmail.com[3], [4]mehakf061@gmail.com, [5]sammansajjad579@gmail.com
[6]ranakamrananwar69@gmail.com

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Corresponding Author: *
Umer Iftikhar

Abstract

Background: *Postoperative wound healing is a critical determinant of surgical outcomes. Hyperglycemia adversely affects leukocyte function, collagen formation, and angiogenesis, leading to delayed healing and increased risk of infection. Optimizing glycemic control before surgery may improve wound recovery and reduce complications.*

Objective: *To evaluate the impact of preoperative glycemic control on postoperative wound healing in elective surgical patients.*

Study Design and Setting: *This prospective observational study was conducted at Sheikh Zayed Hospital, Lahore, from January 2025 to June 2025.*

Methodology: *A total of 140 elective surgical patients aged 18–70 years were enrolled and categorized into two groups based on preoperative HbA1c: well-controlled (≤7%, n=70) and poorly controlled (>7%, n=70). Patients with immunocompromising conditions, chronic steroid use, active infection, or emergency surgery were excluded. Standardized perioperative care, surgical technique, and wound management protocols were applied. Wound healing was assessed on postoperative days 3, 7, and 14 using the Southampton Wound Assessment Scale. Data on demographics, comorbidities, type of surgery, and intraoperative factors were recorded. Statistical analysis was performed using SPSS version 25.0.*

Results: *Well-controlled patients demonstrated faster wound healing, with 92.9% achieving normal wounds by day 14 compared to 68.6% in poorly controlled patients. Mild erythema and discharge persisted more frequently in the poorly controlled group. Postoperative complications such as surgical site infection, wound dehiscence, and prolonged healing were more common in poorly controlled patients.*

Conclusion: *Preoperative glycemic control was associated with improved*

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postoperative wound healing and reduced complication rates. Optimizing glycemia before elective surgery is essential for enhancing surgical outcomes.

INTRODUCTION

Postoperative wound healing is a critical determinant of surgical outcomes, influencing patient recovery, hospital stay, and overall healthcare costs. Optimal wound healing requires a complex interplay of hemostasis, inflammation, proliferation, and remodeling.[1,2] Any disruption in these processes can lead to delayed healing, infection, dehiscence, or chronic wounds, significantly affecting patient morbidity and quality of life. Among the multiple factors influencing wound healing, glycemic control has emerged as a key modifiable risk factor, particularly in patients with diabetes mellitus or impaired glucose metabolism.[3,4]

Hyperglycemia, even transient elevations in blood glucose, is associated with adverse effects on wound healing. Elevated glucose levels impair leukocyte function, reduce chemotaxis, and compromise phagocytosis, increasing susceptibility to infection. Additionally, hyperglycemia alters collagen synthesis, angiogenesis, and fibroblast proliferation, all of which are essential for effective tissue repair.[5] Chronic hyperglycemia is also linked to microvascular and macrovascular complications that reduce tissue perfusion, further delaying wound healing. Consequently, patients with poorly controlled blood glucose are at a higher risk of postoperative complications, including surgical site infections (SSIs), delayed epithelialization, and wound dehiscence.[6]

Elective surgical procedures provide a unique opportunity to optimize preoperative patient conditions, including glycemic control, to minimize postoperative complications. Preoperative assessment often includes evaluation of fasting blood glucose, glycated hemoglobin (HbA1c), and overall metabolic status.[7,8] Evidence suggests that achieving near-normoglycemia before surgery can significantly reduce the incidence of postoperative wound complications. For example, studies have demonstrated that patients with HbA1c levels above 7% are more likely to experience SSIs and prolonged wound healing compared to patients with well-controlled glycemia. Similarly, perioperative hyperglycemia, even in non-diabetic individuals, has been associated with impaired healing and increased postoperative morbidity.[9,10]

Despite the recognized importance of glycemic control, clinical practices vary widely, and the optimal target for preoperative blood glucose remains debated. Some guidelines recommend strict glycemic targets, while others suggest moderate control to balance the risks of hypoglycemia and hyperglycemia. Furthermore, the role of short-term interventions, such as intensive preoperative insulin therapy or oral hypoglycemic adjustments, has been explored, but results are heterogeneous. This variability underscores the need for a clearer understanding of the direct relationship between preoperative glycemic control and postoperative wound healing outcomes.[11]

In addition to clinical implications, the economic burden associated with poor wound healing is substantial. Surgical site infections and delayed healing increase hospitalization duration, readmission rates, and the need for additional interventions, contributing to higher healthcare costs. By optimizing glycemic control before elective surgery, healthcare systems can potentially reduce complications, improve patient outcomes, and lower overall costs. Given the growing prevalence of diabetes and impaired glucose tolerance globally, understanding the impact of preoperative glycemic status on postoperative wound healing is increasingly relevant. This study aims to evaluate the relationship between preoperative glycemic control and postoperative wound healing in elective surgical patients, highlighting the importance of metabolic optimization in improving surgical outcomes and enhancing patient safety.

MATERIALS AND METHODS

A prospective observational study was conducted to assess the impact of preoperative glycemic control on postoperative wound healing in elective surgical patients. A total of 140 patients, aged 18 to 70 years, who were scheduled for elective surgery under

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general or regional anesthesia were enrolled after obtaining informed written consent. Patients with immunocompromising conditions, chronic steroid or immunosuppressive therapy, active infection, renal or hepatic insufficiency, or those undergoing emergency surgery were excluded to minimize confounding factors that could affect wound healing. Preoperative assessment included detailed medical history, physical examination, and laboratory investigations, including fasting blood glucose and glycated hemoglobin (HbA1c) levels. Patients were categorized into two groups based on their preoperative glycemic status: well-controlled (HbA1c ≤7%) and poorly controlled (HbA1c >7%). The sample size of 140 patients was calculated using a standard formula for comparing two means, with 80% power and a 5% level of significance, assuming an expected difference in postoperative wound healing outcomes between groups.

All patients received standardized perioperative care, including antibiotic prophylaxis, surgical technique, and postoperative wound care protocols, to reduce variability. Surgeries were performed by experienced surgeons using aseptic technique, and intraoperative factors such as duration of surgery, blood loss, and type of anesthesia were recorded. Postoperative wound assessment was conducted on days 3, 7, and 14 using the Southampton Wound Assessment Scale, which evaluates erythema, discharge, dehiscence, and signs of infection. Patients' demographic characteristics, comorbidities, body mass index, smoking status, and type of surgery were documented as potential confounding variables.Glycemic control was monitored both preoperatively and postoperatively. Fasting blood glucose was measured on the day of surgery and daily for the first three postoperative days. Any deviations from the normal glycemic range were managed according to standardized hospital protocols, including insulin therapy if required. Wound healing outcomes were compared between the well-controlled and poorly controlled groups to evaluate the effect of preoperative glycemic status on postoperative recovery.

Data were analyzed using SPSS version 25.0. Continuous variables were presented as mean ± standard deviation and compared using independent t-tests, while categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test where appropriate. A p-value of <0.05 was considered statistically significant. The study was approved by the institutional ethical review committee and was conducted in accordance with the principles of the Declaration of Helsinki, ensuring patient confidentiality and adherence to ethical standards.

STUDY RESULTS

The study included a total of 140 patients, with 70 patients in the well-controlled glycemic group and 70 in the poorly controlled group. The mean age of patients was comparable between the well-controlled and poorly controlled groups (52.4 ± 10.1 years vs. 53.8 ± 9.7 years, p=0.42). Males accounted for 54.3% in the well-controlled group and 50% in the poorly controlled group, while females were 45.7% and 50%, respectively (p=0.61). The mean body mass index was slightly higher in the poorly controlled group (28.3 ± 4.1 kg/m²) compared to the well-controlled group (27.1 ± 3.5 kg/m²), though the difference was not statistically significant (p=0.08). The proportion of smokers and patients with hypertension was similar between groups (p>0.05) as given in table 1.

Preoperative glycemic parameters were significantly different between the groups. The mean fasting blood glucose was 102.3 ± 8.5 mg/dL in the well-controlled group and 148.7 ± 15.6 mg/dL in the poorly controlled group (p<0.001). Similarly, mean HbA1c was 6.4 ± 0.3% in the well-controlled group and 8.2 ± 0.6% in the poorly controlled group (p<0.001) as given in table 2.

Postoperative wound healing outcomes were assessed using the Southampton Wound Assessment Scale. On postoperative day 3, 50% of patients in the well-controlled group had normal wounds (Grade 0) compared to 25.7% in the poorly controlled group. Mild to moderate wound complications (Grades 1–3) were more frequent in the poorly controlled group, although severe complications (Grade 4) were absent in both groups. By day 7, 71.4% of patients in the well-controlled group had normal wounds versus 42.9% in the poorly controlled group, with a trend toward higher rates of mild discharge and erythema in poorly controlled patients. On day 14, the majority of well-controlled patients (92.9%)

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achieved complete wound healing, while only 68.6% of poorly controlled patients had normal wounds. Mild erythema and discharge persisted more frequently in the poorly controlled group as given in table 3,4,5 respectively.

Overall postoperative complications were more frequent in the poorly controlled group. Surgical site infection occurred in 10% of poorly controlled patients compared to 2.9% in the well-controlled group. Wound dehiscence was observed in 5.7% of poorly controlled patients versus 1.4% of well-controlled patients. Prolonged healing beyond 14 days occurred only in the poorly controlled group (8.6%) and was absent in the well-controlled group as given in table 6.

Table 1. Demographic and Clinical Characteristics of Study Patients

Characteristic	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Age (years), mean ± SD	52.4 ± 10.1	53.8 ± 9.7	0.42
Male, n (%)	38 (54.3%)	35 (50.0%)	0.61
Female, n (%)	32 (45.7%)	35 (50.0%)	0.61
BMI (kg/m²), mean ± SD	27.1 ± 3.5	28.3 ± 4.1	0.08
Smoking, n (%)	15 (21.4%)	18 (25.7%)	0.53
Hypertension, n (%)	28 (40.0%)	32 (45.7%)	0.48

Table 2. Preoperative Glycemic Parameters

Parameter	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Fasting Blood Glucose (mg/dL), mean ± SD	102.3 ± 8.5	148.7 ± 15.6	<0.001
HbA1c (%), mean ± SD	6.4 ± 0.3	8.2 ± 0.6	<0.001

Table 3. Postoperative Wound Healing Outcomes (Southampton Scale) – Day 3

Southampton Grade	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Grade 0 (Normal)	35 (50.0%)	18 (25.7%)	0.003
Grade 1 (Erythema)	25 (35.7%)	30 (42.9%)	0.36
Grade 2 (Mild Discharge)	8 (11.4%)	16 (22.9%)	0.08
Grade 3 (Moderate Discharge)	2 (2.9%)	6 (8.6%)	0.16
Grade 4 (Severe Infection)	0 (0%)	0 (0%)	–

Table 4. Postoperative Wound Healing Outcomes – Day 7

Southampton Grade	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Grade 0 (Normal)	50 (71.4%)	30 (42.9%)	<0.001
Grade 1 (Erythema)	15 (21.4%)	25 (35.7%)	0.07
Grade 2 (Mild Discharge)	4 (5.7%)	10 (14.3%)	0.09
Grade 3 (Moderate Discharge)	1 (1.4%)	5 (7.1%)	0.11
Grade 4 (Severe Infection)	0 (0%)	0 (0%)	–

Table 5. Postoperative Wound Healing Outcomes – Day 14

Southampton Grade	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Grade 0 (Normal)	65 (92.9%)	48 (68.6%)	<0.001
Grade 1 (Erythema)	4 (5.7%)	12 (17.1%)	0.04
Grade 2 (Mild Discharge)	1 (1.4%)	8 (11.4%)	0.03
Grade 3 (Moderate Discharge)	0 (0%)	2 (2.9%)	0.15
Grade 4 (Severe Infection)	0 (0%)	0 (0%)	–

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Table 6. Postoperative Complications

Complication	Well-Controlled (n=70)	Poorly Controlled (n=70)	p-value
Surgical Site Infection, n (%)	2 (2.9%)	7 (10.0%)	0.09
Wound Dehiscence, n (%)	1 (1.4%)	4 (5.7%)	0.17
Prolonged Healing (>14 days), n (%)	0 (0%)	6 (8.6%)	0.02

DISCUSSION

Postoperative wound healing is a key factor influencing recovery, morbidity, and hospital stay in surgical patients. Hyperglycemia impairs leukocyte function, collagen synthesis, and angiogenesis, leading to delayed healing and higher infection risk. Preoperative glycemic control is crucial in optimizing surgical outcomes, particularly in elective procedures.[12,13] Patients with poorly controlled blood glucose often experience slower wound repair and higher complication rates. Elective surgeries provide an opportunity to correct metabolic imbalances before intervention.[14] Understanding the relationship between glycemic status and wound healing can guide perioperative management and improve patient safety.

In this study, preoperative glycemic control was found to have a significant impact on postoperative wound healing in elective surgical patients. Patients with well-controlled glycemia (HbA1c ≤7%) exhibited faster wound healing, with 92.9% achieving normal wounds by day 14, compared to 68.6% in the poorly controlled group. Mild erythema and discharge persisted more frequently in poorly controlled patients, and postoperative complications such as surgical site infection, wound dehiscence, and prolonged healing were higher in this group. These findings align closely with the results of Shahzad et al. (2024), who reported that the frequency of postoperative wound infection was significantly higher in diabetic patients, with 50% in the poorly controlled group versus 16.7% in non-diabetic patients (p=0.006).[15] Similarly, Fadhil et al. (2025) observed that diabetic patients undergoing abdominal surgery experienced higher SSI rates (30% vs. 10%), longer healing times (18.1 ± 4.6 vs. 12.5 ± 2.9 days), and greater wound dehiscence (12% vs. 2%) compared to non-diabetics (p<0.05).[18]

The present study also corroborates the findings of Ahmed et al. (2020), where among 163 diabetic patients undergoing elective and emergency surgery, 33.1% developed superficial SSI and 12.3% developed deep SSI, highlighting the increased susceptibility of patients with poor glycemic control to postoperative infections.[16] Maqsood et al. (2022) emphasized the predictive value of HbA1c for SSI, demonstrating a statistically significant association between HbA1c >6.5% and the presence of SSI (p=0.011), further supporting our approach of using HbA1c as a reliable preoperative marker rather than relying solely on fasting blood glucose.[19] Farid et al. (2025) also reported significantly higher postoperative complications in poorly controlled patients (64.8%) compared to well-controlled patients (20%, p<0.001), which is consistent with our findings of increased wound-related complications in patients with elevated HbA1c.[20]

Moreover, the predictive role of preoperative HbA1c levels in surgical outcomes has been highlighted by Syeda et al. (2019), who found that higher HbA1c was associated with increased postoperative mortality and complications in the first 7 and 30 days (p<0.001). Our study supports this evidence, indicating that inadequate glycemic control can prolong healing and predispose patients to wound infections and minor complications even in elective settings.[17] While age, sex, BMI, and type of surgery were comparable between groups in our study, the key differentiating factor for wound healing outcomes was glycemic control, reinforcing the critical role of metabolic optimization prior to surgery.

Overall, the findings of this study are consistent with existing literature, emphasizing that well-controlled preoperative glycemia is essential for reducing postoperative wound complications, accelerating healing, and improving overall surgical outcomes. Monitoring HbA1c and addressing hyperglycemia before elective procedures should be considered a standard component of preoperative assessment to enhance patient safety and reduce postoperative morbidity.

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The study was prospective and included standardized perioperative care, minimizing confounding factors. Wound healing was assessed using a validated scale at multiple postoperative time points. The sample size of 140 patients was adequate for statistical comparison. Limitations included a single-center design, which may limit generalizability. Long-term complications beyond 14 days were not assessed. Glycemic fluctuations during hospitalization could not be fully controlled.

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CONCLUSION

Preoperative glycemic control was associated with faster wound healing and fewer postoperative complications. Poorly controlled patients experienced delayed recovery and higher rates of mild to moderate wound issues. Optimizing glycemia before elective surgery is essential for improving surgical outcomes.

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