

Controlled Diabetes and Surgical Wound Outcomes: A Comparative Analysis

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ABSTRACT

Background: This prospective comparative study evaluated postoperative outcomes in patients with and without controlled type II diabetes mellitus undergoing elective surgical procedures.

Methods: Conducted at the Department of Surgery, Combined Military Hospital (CMH), Rawalpindi, Pakistan, from June 2023 to January 2024, the study included 300 adult patients aged 18–65 years. Participants were stratified into two groups: Group A comprised 139 patients with controlled type II diabetes (HbA1c $\leq 7\%$), while Group B included 161 non-diabetic patients. Standardized operative protocols and perioperative care were maintained across groups to ensure comparability. Postoperative complications were assessed over a 30-day follow-up, including surgical site infections (SSIs), seroma, abscess, and wound dehiscence.

Results: Results showed higher complication rates in diabetic patients, with abscess formation (13.7% vs. 5.6%, $p=0.01$) and wound dehiscence (8.6% vs. 3.1%, $p=0.02$) significantly more frequent in Group A. Although SSIs (9.4% vs. 6.2%) and seroma formation (7.2% vs. 5.6%) were also higher in diabetics, differences were not statistically significant ($p>0.05$).

Conclusion: These findings suggest that even well-controlled diabetes predisposes patients to adverse wound outcomes, particularly abscess and dehiscence. Comprehensive perioperative risk stratification and intensified postoperative monitoring are recommended to mitigate complications.

Keywords: Controlled diabetes, elective surgery, wound complications, surgical site infection, postoperative outcomes.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder with profound implications for global health and surgical outcomes¹. The International Diabetes Federation (IDF) estimates that approximately 537 million adults worldwide were living with diabetes in 2021, a number projected to escalate to 783 million by 2045, with type II diabetes accounting for more than 90% of all cases². This rising prevalence underscores the importance of understanding the systemic consequences of diabetes, especially in surgical populations where impaired wound healing and postoperative morbidity are of particular concern. Surgical procedures represent a unique physiological challenge, and the presence of diabetes—even when apparently well controlled—can significantly alter the trajectory of recovery and wound repair³.

The process of wound healing is a complex cascade involving inflammation, proliferation, angiogenesis, and remodeling, all of which can be disrupted in the diabetic milieu^{4,5}. Hyperglycemia, even at modestly elevated levels, has been shown to impair leukocyte chemotaxis, phagocytic function, and bactericidal activity, thereby weakening host defenses against infection⁶. Furthermore, chronic diabetes induces microvascular dysfunction, reduces oxygen delivery, and alters collagen synthesis, collectively leading to delayed tissue repair and increased wound fragility⁷. These mechanisms provide the biological rationale for the heightened risk of surgical site infections (SSIs), abscess formation, seromas, and wound dehiscence observed in diabetic individuals compared with their non-diabetic counterparts.

Surgical site infections remain among the most frequent postoperative complications worldwide, contributing substantially to patient morbidity, prolonged hospital stay, and healthcare costs⁸. The Centers for Disease Control and Prevention (CDC, 2020) report that SSIs account for nearly 20% of all healthcare-associated infections, highlighting the burden of this preventable condition^{9,10}. In surgical patients with diabetes, the

risk is compounded: previous studies have demonstrated a two- to four-fold increase in SSIs compared with non-diabetic populations¹¹. Moreover, wound dehiscence and abscess formation, which reflect deeper disruptions in tissue repair mechanisms, have also been found to occur with greater frequency in diabetic patients. These findings underscore that diabetes impacts not only superficial wound healing but also the structural integrity of deeper tissues¹².

The role of glycemic control in mitigating surgical risk has been extensively debated. Hemoglobin A1c (HbA1c), a widely used marker of glycemic control, has been incorporated into perioperative risk stratification, with values $\leq 7\%$ typically considered indicative of well-controlled diabetes¹³. While intensive glycemic management has been associated with reduced rates of infection and improved wound outcomes in some studies, emerging evidence suggests that glycemic control alone may not fully eliminate the risks associated with diabetes. Subtle alterations in immune function, vascular biology, and tissue repair persist even in patients achieving target HbA1c levels, suggesting that “controlled” diabetes is not synonymous with “normal” physiology¹⁴. This raises important clinical questions regarding whether controlled diabetics remain at elevated risk for adverse surgical outcomes compared with non-diabetic individuals¹⁵.

Despite growing recognition of this issue, there remains limited data from low- and middle-income countries, where the prevalence of diabetes is rising disproportionately and where healthcare systems face additional resource constraints¹⁶. In South Asia, for instance, Pakistan ranks among the top ten countries in terms of diabetes prevalence, with nearly one in six adults estimated to be affected¹⁷. Yet, few studies from the region have systematically compared surgical wound outcomes between patients with controlled diabetes and non-diabetic individuals¹⁸. Given the unique demographic and clinical characteristics of this population including younger age of onset, higher rates of obesity, and limited perioperative resources locally generated evidence is crucial for guiding surgical care.

Understanding whether controlled diabetic patients are at comparable risk to their non-diabetic peers has significant implications for perioperative management. If controlled diabetes continues to predispose patients to wound complications, surgical teams may need to adopt more intensive surveillance protocols, multidisciplinary involvement, and patient counseling strategies. Conversely, if complication rates approach those of non-diabetic individuals, this would provide reassurance regarding the adequacy of current glycemic targets in mitigating surgical risk.

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Against this backdrop, the present prospective comparative study was conducted to evaluate postoperative wound-related complications in patients with controlled type II diabetes mellitus and those without diabetes undergoing elective surgical procedures in a tertiary care setting in Pakistan. By systematically documenting outcomes such as SSIs, seromas, abscess formation, and wound dehiscence over a 30-day follow-up period, this study aims to generate robust local evidence addressing an important gap in the literature. The findings are expected to contribute to a more nuanced understanding of the relationship between glycemic control and surgical outcomes, while informing clinical practice and perioperative strategies in diabetic populations.

METHODOLOGY

This prospective comparative study was carried out at the Department of Surgery, Combined Military Hospital (CMH), Rawalpindi, Pakistan, over a one-year period from June 2023 to January 2024. A total of 300 patients scheduled for elective surgical procedures were recruited using non-probability consecutive sampling. Eligible participants included adult patients aged 18–65 years undergoing elective surgery under general or regional anesthesia. Patients with uncontrolled diabetes mellitus, immunocompromised states, ongoing infections, or those requiring emergency procedures were excluded to minimize confounding factors.

Enrolled patients were stratified into two groups: Group A comprised individuals with previously diagnosed, controlled type II diabetes mellitus, as defined by HbA1c $\leq 7\%$ at the time of surgery, while Group B included patients without type II diabetes mellitus. All surgical procedures were performed following standardized operative protocols by consultant surgeons, and perioperative care, including antibiotic prophylaxis, aseptic measures, and postoperative monitoring, was uniform across both groups to ensure comparability.

Postoperative follow-up was conducted for a period of 30 days. Patients were evaluated through both inpatient assessment and scheduled outpatient clinic visits. Complications of interest included surgical site infections (SSIs), seroma formation, abscess development, and wound dehiscence. The diagnosis of SSI was made according to Centers for Disease Control and Prevention (CDC) criteria, while other complications were confirmed clinically and, where appropriate, by ultrasonographic evaluation. Data were recorded on predesigned proformas and entered into SPSS version 26.0 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics were used to summarize baseline demographics and clinical characteristics. Continuous variables such as age were expressed as mean $\pm$ standard deviation, while categorical variables such as sex and presence of complications were reported as frequencies and percentages. Comparative analysis between groups was performed using the Chi-square test for categorical variables and independent t-test for continuous variables. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 300 patients who fulfilled the inclusion criteria were enrolled and successfully completed follow-up during the study period. The mean age of participants was 39.9 ± 8.5 years (range: 18–65 years). The study population comprised 222 males (74%) and 78 females (26%). Of the total, 139 patients (34.8%) were diagnosed with controlled type II diabetes mellitus (Group A), while 261 patients (65.2%) had no history of diabetes (Group B). Baseline demographic characteristics were comparable between both groups (Table 1).

Overall, the incidence of postoperative complications was higher among patients with controlled diabetes mellitus. Surgical site infections were observed in 23 patients (7.7%), seroma formation in 19 patients (6.3%), abscess formation in 28 patients (9.3%), and wound dehiscence in 17 patients (5.7%). Abscess formation and wound dehiscence occurred significantly more frequently in

the diabetic group compared with the non-diabetic group ($p < 0.05$). The rates of surgical site infections and seroma formation were higher in the diabetic group but did not reach statistical significance ($p > 0.05$). A detailed comparison of complications between groups is presented in Table 2.

Table 1: Baseline Demographic Characteristics of Study Participants (N = 300)

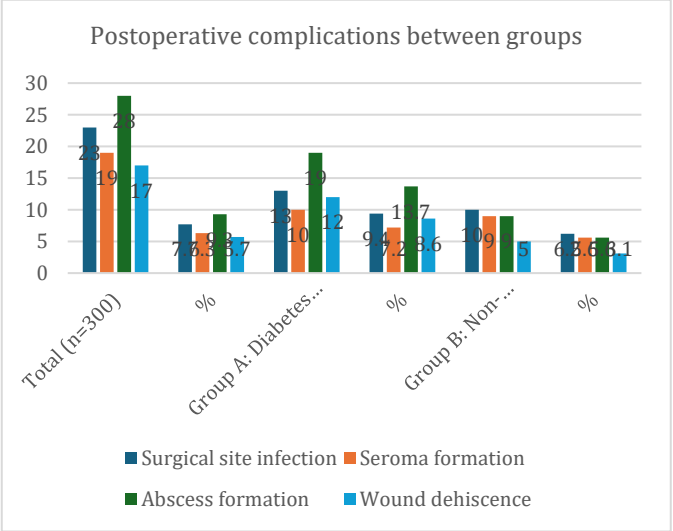
Variable	Total (n=300)	Group A Diabetes (n=139)	Group B Non-diabetes (n=161)	p-value
Age, years (mean $\pm$ SD)	39.9 $\pm$ 8.5	40.7 $\pm$ 8.2	39.2 $\pm$ 8.7	0.18
Male, n (%)	222 (74.0)	101 (72.7)	121 (75.2)	0.64
Female, n (%)	78 (26.0)	38 (27.3)	40 (24.8)	

Table 2: Postoperative Complications Between Groups

Complication	Total (n=300)	Group A Diabetes (n=139)	Group B Non-diabetes (n=161)	p-value
Surgical site infection, n (%)	23 (7.7)	13 (9.4)	10 (6.2)	0.29
Seroma formation, n (%)	19 (6.3)	10 (7.2)	9 (5.6)	0.56
Abscess formation, n (%)	28 (9.3)	19 (13.7)	9 (5.6)	0.01*
Wound dehiscence, n (%)	17 (5.7)	12 (8.6)	5 (3.1)	0.02*

*Statistically significant ($p < 0.05$)

Figure 1



DISCUSSION

The present prospective comparative study investigated postoperative outcomes in patients with and without controlled type II diabetes mellitus undergoing elective surgical procedures. Our findings demonstrate that although most patients did not develop serious complications, the presence of diabetes mellitus, even when optimally controlled at the time of surgery, was associated with a significantly higher risk of abscess formation and wound dehiscence compared with non-diabetic counterparts. These results highlight the complex interplay between metabolic status and wound healing, underscoring the importance of vigilant perioperative care in diabetic patients.

The increased risk of wound-related complications in diabetic individuals has been consistently reported in previous studies. Impaired leukocyte function, reduced microvascular perfusion, and altered collagen synthesis are among the key pathophysiological mechanisms contributing to delayed wound healing and heightened susceptibility to infection (Guo & DiPietro, 2010; Martin, 2013). Our observation that abscess formation and wound dehiscence occurred more frequently in the diabetic cohort aligns with these biological mechanisms, reinforcing the need for heightened surveillance. Interestingly, while the rates of surgical site infections and seroma formation were also higher in

diabetic patients, these differences were not statistically significant, suggesting that the most pronounced vulnerability may lie in deeper or more severe wound complications. Our findings add to the growing body of evidence that perioperative glycemic optimization alone may not fully mitigate surgical risks in diabetic patients. Previous research has suggested that even well-controlled diabetes is associated with subtle immunological and vascular impairments that persist despite normoglycemia (Moghissi et al., 2009). This may explain why patients with controlled diabetes in our study continued to experience higher complication rates compared with non-diabetic patients.

From a clinical standpoint, these results carry important implications for surgical practice. Preoperative assessment of diabetic patients should not only focus on glycemic control but also incorporate comprehensive risk stratification, including nutritional status, body mass index, and vascular health. Postoperatively, intensified wound surveillance, early intervention in cases of suspected infection, and multidisciplinary involvement of endocrinologists, surgeons, and wound care specialists may reduce adverse outcomes. Moreover, patient counseling should emphasize the persistent elevated risk of wound complications despite adequate glycemic control, preparing patients for closer follow-up and preventive strategies. The strengths of this study include its prospective design, standardized operative protocols, and systematic follow-up, which minimize bias and enhance the reliability of findings. However, certain limitations must be acknowledged. First, the single-center design may limit generalizability to broader populations. Second, long-term outcomes beyond 30 days were not assessed, potentially underestimating delayed complications. Third, while HbA1c was used to define controlled diabetes, variability in perioperative glucose fluctuations could not be fully accounted for, which may have influenced complication rates. In conclusion, our study demonstrates that patients with controlled type II diabetes mellitus remain at elevated risk of postoperative wound complications, particularly abscess formation and wound dehiscence, compared with non-diabetic patients undergoing elective surgery. These findings highlight the

need for comprehensive perioperative strategies that extend beyond glycemic optimization to improve surgical outcomes in this vulnerable population.

CONCLUSION

This study demonstrates that patients with controlled type II diabetes mellitus undergoing elective surgery remain at elevated risk of postoperative wound-related complications compared with non-diabetic patients. Specifically, abscess formation and wound dehiscence were significantly more common in diabetic individuals, underscoring the persistent effects of metabolic dysregulation on tissue healing despite adequate glycemic control. The findings highlight that perioperative optimization of blood glucose, while important, may not be sufficient to fully mitigate surgical risks in this population. Clinicians should adopt a multidisciplinary approach that includes rigorous preoperative assessment, vigilant postoperative wound monitoring, and timely intervention for suspected complications. Patient education regarding the increased likelihood of wound complications is equally essential to encourage adherence to follow-up care. Future multicenter studies with longer follow-up are warranted to further refine perioperative strategies aimed at improving surgical outcomes in diabetic patients.

Author's Contribution

AK: Concept & study design, data collection and drafting of the manuscript.

FG: Data entry, statistical analysis, interpretation of the results.

SK: Manuscript editing and critical revision of the manuscript.

All authors approved the final version of the manuscript to be published.

Conflict of Interest

The authors declared no conflict of interest.

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Data Availability

Data is available with authors and can be provided on request.

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