MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.7.68.73

Role of Postoperative Glycemic Control in Reducing Surgical Site Infections in Diabetic Patients Undergoing Abdominal Surgery

[1]Ramesh Lingala, [2]C.H. Santhosh Babu, [3]Srikanth Jukuru and [4]Praveen Mangalagiri

[1-4]Department of General Surgery, Government Medical College Nalgonda, Telangana, India

Abstract

Surgical site infections (SSIs) are a significant complication following abdominal surgery, particularly in diabetic patients who are inherently at higher risk due to impaired immune responses and poor wound healing associated with hyperglycemia. This study aimed to evaluate the role of postoperative glycemic control in reducing the incidence of SSIs in diabetic patients undergoing abdominal surgery. This prospective cohort study was conducted at the Department of Surgery, Government Medical College, Nalgonda, Telangana, over one year. A total of 75 diabetic patients undergoing elective abdominal surgery were enrolled. Postoperative blood glucose levels were monitored at 6-hour intervals for the first 48 hours, then daily until discharge. The primary outcome measure was the incidence of SSIs, monitored on postoperative days 7, 14 and 30. Data were analyzed using SPSS version 25.0, with logistic regression analysis to identify independent predictors of SSIs. The mean age of the participants was 55.3±10.7 years, with 53.3% being male. Type 2 diabetes was present in 80.0% of patients, with a mean diabetes duration of 12.5±7.8 years. The mean preoperative HbA1c level was 8.2±1.5%. Postoperative glycemic control improved progressively, with 93.3% of patients achieving target blood glucose levels (80-180 mg/dL) by discharge. The overall incidence of SSIs was 16.0% by postoperative day 30, with a significant reduction observed in patients who maintained blood glucose within the target range. Maintaining stringent postoperative glycemic control significantly reduces the incidence of SSIs in diabetic patients undergoing abdominal surgery. These findings highlight the importance of regular blood glucose monitoring and tailored insulin therapy in the preoperative management of diabetic patients. Future research should focus on larger, multi center trials to validate these findings and explore the impact of advanced glycemic control technologies.

OPEN ACCESS

Key Words

Postoperative glycemic control, surgical site infections, abdominal surgery, diabetes mellitus, blood glucose monitoring, Insulin

Corresponding Author

Praveen Mangalagiri,
Department of General Surgery, Government Medical College Nalgonda, Telangana, India
pravmangalagiri@gmail.com

Author Designation

[1,2]Associate Professor
[3,4]Assistant Professor

Received: 20 April 2024
Accepted: 29 May 2024
Published: 5 June 2024

Citation: Ramesh Lingala, C.H. Santhosh Babu, Srikanth Jukuru and Praveen Mangalagiri, 2024. Role of Postoperative Glycemic Control in Reducing Surgical Site Infections in Diabetic Patients Undergoing Abdominal Surgery. Res. J. Med. Sci., 18: 68-73, doi: 10.36478/makrjms.2024.7.68.73

INTRODUCTION

Surgical site infections (SSIs) are a significant complication following abdominal surgery, particularly in diabetic patients who are inherently at higher risk due to impaired immune responses and poor wound healing associated with hyperglycemia[1]. Despite advancements in surgical techniques and perioperative care, SSIs continue to pose a substantial burden on healthcare systems, leading to prolonged hospital stays, increased healthcare costs and higher morbidity and mortality rates[2]. Maintaining optimal blood glucose levels postoperatively has been suggested to enhance immune function, promote better wound healing and consequently reduce infection rates[3]. However, there remains a gap in the literature regarding the specific impact of strict glycemic control on SSIs in the diabetic population undergoing abdominal surgeries. Existing studies have primarily focused on the general surgical population or have not adequately stratified results by diabetes status, leading to inconclusive or generalized findings that may not fully apply to diabetic patients.

Diabetes mellitus significantly increases the risk of postoperative complications, with SSIs being among the most common. Poor glycemic control can impair leukocyte function, reduce collagen synthesis and promote an environment conducive to bacterial growth, thereby increasing the susceptibility to infections[4]. Despite these well-known mechanisms, there is a lack of consensus on the optimal glycemic targets and the best strategies to achieve these targets in the preoperative period for diabetic patients. Most guidelines are based on evidence derived from non-diabetic populations or mixed cohorts, which may not adequately address the unique pathophysiological challenges faced by diabetic patients.

Several studies have explored the correlation between hyperglycemia and SSIs, such as the work by Umpierrez *et al*. (2002), which demonstrated that hyperglycemia is an independent predictor of adverse outcomes in diabetic patients undergoing surgery[5]. However, there is limited prospective data focusing specifically on abdominal surgeries, a category particularly susceptible to SSIs due to the complexity and inherent risk of contamination. Additionally, existing research often fails to account for variations in surgical techniques, patient comorbidities, and postoperative care protocols, leading to inconsistent results and recommendations.

Given the rising prevalence of diabetes globally, there is an urgent need for tailored preoperative management strategies to improve surgical outcomes in this vulnerable population. Understanding the specific role of postoperative glycemic control in preventing SSIs can lead to the development of targeted interventions, which may include stricter glucose monitoring protocols, individualized insulin therapy and enhanced postoperative care regimens[6].

This study aims to fill the existing gap by providing robust, prospective data on the impact of postoperative glycemic control in diabetic patients undergoing abdominal surgery. By controlling for confounding variables and focusing on a specific surgical category, the findings can offer clearer guidance for clinicians. Additionally, this research can contribute to updating clinical guidelines, ensuring that they reflect the latest evidence-based practices for managing diabetic patients in the surgical setting. The aim of this study is to evaluate the role of postoperative glycemic control in reducing the incidence of SSIs in diabetic patients undergoing abdominal surgery.

MATERIALS AND METHODS

This prospective cohort study was conducted at the Department of Surgery, Government Medical College, Nalgonda, Telangana, over a period of one year from October 2023 to March 2024. The study aimed to evaluate the role of postoperative glycemic control in reducing the incidence of surgical site infections (SSIs) in diabetic patients undergoing abdominal surgery.

Study Population: The study included diabetic patients who were admitted to the Department of Surgery for elective abdominal surgery.

Inclusion Criteria Were as Follows:

- Patients aged 18 years and above.
- Diagnosed with Type 1 or Type 2 diabetes mellitus.
- Undergoing elective abdominal surgery.
- Provided informed consent to participate in the study.

Exclusion Criteria Included:

- Non-diabetic patients.
- Patients undergoing emergency abdominal surgeries.
- Patients with pre-existing infections or immuno suppressive conditions.
- Patients who did not consent to participate.

Sample Size: A total of 75 diabetic patients who met the inclusion criteria were enrolled in the study. This sample size was determined based on the feasibility and resources available at the study center.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of Government Medical

College, Nalgonda. Written informed consent was obtained from all participants after explaining the study's purpose, procedures, potential risks and benefits.

Data Collection: Data were collected using a structured questionnaire and medical records. The following variables were recorded:

- Demographic information (age, sex).
- Clinical characteristics (type and duration of diabetes, comorbidities).
- Surgical details (type of abdominal surgery, duration of surgery, use of drains).
- Preoperative glycemic control (HbA1c levels).
- Postoperative glycemic control (blood glucose levels monitored at 6-hour intervals for the first 48 hours, then daily until discharge).

Procedure

Preoperative Assessment: All patients underwent a thorough preoperative assessment, including evaluation of glycemic control (HbA1c levels) and screening for comorbid conditions.

Surgical Procedure: Standard aseptic techniques were employed during all surgeries. The type of abdominal surgery performed was recorded.

Postoperative Management: Blood glucose levels were monitored at regular intervals (every 6 hours for the first 48 hours, then daily) using a glucometer. Insulin therapy was adjusted accordingly to maintain target blood glucose levels.

Follow-Up: Patients were followed up on postoperative days 7, 14 and 30 to monitor for signs of SSIs. Any infection was documented and managed according to standard protocols.

Intervention: Postoperative glycemic control was managed according to standard clinical protocols. Blood glucose levels were maintained within a target range of 80-180 mg/dL using insulin therapy. Adjustments to insulin dosage were made based on regular monitoring and clinical judgment.

Outcome Measures: The primary outcome measure was the incidence of SSIs, defined according to the Centers for Disease Control and Prevention (CDC) criteria. SSIs were monitored and recorded during the hospital stay and at follow-up visits on postoperative days 7, 14 and 30.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean±standard deviation (SD) and categorical variables as frequencies and percentages. The incidence of SSIs was compared between patients with controlled and uncontrolled postoperative blood glucose levels using the chi-square test. Logistic regression analysis was performed to identify independent predictors of SSIs. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

(Table 1) presents the demographic information of the 75 diabetic patients included in the study. The mean age of the participants was 55.3 years with a standard deviation of 10.7 years, indicating a middle-aged cohort with some variability in age. The sex distribution of the patients showed a slight predominance of males, with 53.3% (40 patients) being male and 46.7% (35 patients) being female. This demographic data provides a baseline understanding of the study population, which is essential for interpreting the subsequent findings related to postoperative glycemic control and surgical site infections.

(Table 2) provides detailed information on the clinical characteristics of the 75 diabetic patients enrolled in the study. The majority of the participants, 80.0%, had Type 2 diabetes, while 20.0% had Type 1 diabetes. The mean duration of diabetes among the patients was 12.5 years with a standard deviation of 7.8 years, indicating a wide range of disease duration among the participants.

Regarding comorbidities, 53.3% of the patients had hypertension, making it the most common comorbidity. Hyperlipidemia was present in 33.3% of the patients, while 20.0% had cardiovascular disease. Chronic kidney disease was noted in 13.3% of the participants, and other comorbid conditions, such as chronic obstructive pulmonary disease (COPD) and asthma, were present in 10.7% of the patients.

This table highlights the varied clinical profiles of the study participants, which is crucial for understanding the impact of these factors on postoperative outcomes and the potential influence on the incidence of surgical site infections.

(Table 3) summarizes the surgical details of the 75 diabetic patients who underwent abdominal surgery. The types of surgeries included appendectomy (13.3%), cholecystectomy (26.7%), colectomy (20.0%), hernia repair (16.0%), gastric surgery (10.7%) and other procedures (13.3%).

The mean duration of surgery was 2.3 hours with a standard deviation of 1.1 hours, indicating variability in the complexity and length of the procedures performed. Additionally, the use of surgical drains was recorded, with 66.7% of the patients having drains placed postoperatively, while 33.3% did not have drains.

Table 1: Demographic Information of Study Participants (N=75)

Variable	Mean±SD	Frequency (%)
Age (years)	55.3±10.7	
Sex		
Male		40 (53.3)
Female		35 (46.7)

Table 2: Clinical Characteristics of Study Participants (N=75)

Variable	Mean±SD	Frequency (%)
Type of Diabetes		
Type 1 Diabetes		15 (20.0)
Type 2 Diabetes		60 (80.0)
Duration of Diabetes (years)	12.5±7.8	
Comorbidities		
Hypertension		40 (53.3)
Hyperlipidemia		25 (33.3)
Cardiovascular Disease		15 (20.0)
Chronic Kidney Disease		10 (13.3)
Other (e.g., COPD, Asthma)		8 (10.7)

Table 3: Surgical Details of Study Participants (N=75)

Variable	Mean±SD	Frequency (%)
Type of Abdominal Surgery		
Appendectomy		10 (13.3)
Cholecystectomy		20 (26.7)
Colectomy		15 (20.0)
Hernia Repair		12 (16.0)
Gastric Surgery		8 (10.7)
Other		10 (13.3)
Duration of Surgery (hours)	2.3±1.1	
Use of Drains		
Yes		50 (66.7)
No		25 (33.3)

Table 4: Preoperative Glycemic Control of Study Participants (N=75)

Variable	Mean±SD	Frequency (%)
HbA1c Levels (%)	8.2±1.5	
HbA1c Categories		
< 7%		15 (20.0)
7-8.9%		35 (46.7)
= 9%		25 (33.3)

Table 5: Postoperative Glycemic Control of Study Participants (N=75)

Time Interval	Mean ± SD (mg/dL)	Frequency (%) (Patients with Blood Glucose Levels within Target Range of 80-180 mg/dL)
6-hour intervals (first 48 hours)		
0-6 hours	175±30	45 (60.0)
6-12 hours	180±35	40 (53.3)
12-18 hours	185±40	38 (50.7)
18-24 hours	170±28	50 (66.7)
24-30 hours	165±25	55 (73.3)
30-36 hours	160±20	60 (80.0)
36-42 hours	155±22	65 (86.7)
42-48 hours	150±20	68 (90.7)
Daily until discharge	140±18	70 (93.3)

Table 6: Follow-Up and Incidence of Surgical Site Infections (SSIs) (N=75)

Follow-Up Day	Frequency (%)
Postoperative Day 7	
No SSI	68 (90.7)
SSI	7 (9.3)
Postoperative Day 14	
No SSI	65 (86.7)
SSI	10 (13.3)
Postoperative Day 30	
No SSI	63 (84.0)
SSI	12 (16.0)

This table provides a comprehensive overview of the surgical interventions and postoperative management practices, which are essential for analyzing their potential impact on the incidence of surgical site infections and the role of postoperative glycemic control in this cohort.

(Table 4) presents the preoperative glycemic control of the 75 diabetic patients as measured by their HbA1c levels. The mean HbA1c level was 8.2% with a standard deviation of 1.5%, indicating that, on average, the patients had suboptimal glycemic control prior to surgery.

The distribution of HbA1c levels among the patients shows that 20.0% had HbA1c levels below 7%, which is considered good glycemic control. A significant portion of the cohort, 46.7%, had HbA1c levels between 7% and 8.9%, indicating moderate control, while 33.3% had HbA1c levels of 9% or higher, reflecting poor glycemic control.

This data is crucial as it provides a baseline understanding of the patients' glycemic status before surgery, which can influence postoperative outcomes, including the risk of surgical site infections. Analyzing the impact of preoperative glycemic control on postoperative complications will help in understanding its role in improving surgical outcomes in diabetic patients.

(Table 5) provides detailed information on the postoperative glycemic control of the 75 diabetic patients, with blood glucose levels monitored at 6-hour intervals for the first 48 hours and then daily until discharge. The mean blood glucose levels and the percentage of patients with blood glucose levels within the target range of 80-180 mg/dL are presented for each time interval.

During the initial 0-6 hours post-surgery, the mean blood glucose level was 175 mg/dL, with 60.0% of patients maintaining levels within the target range. Over the next intervals, there were fluctuations in the mean blood glucose levels, peaking at 185 mg/dL during the 12-18 hour interval, with only 50.7% of patients within the target range.

As the postoperative period progressed, there was a gradual improvement in glycemic control. By the 24-30 hour interval, 73.3% of patients had blood glucose levels within the target range, with a mean level of 165 mg/dL. This trend continued and by the 42-48 hour interval, 90.7% of patients were within the target range, with a mean blood glucose level of 150 mg/dL.

Daily monitoring until discharge showed further stabilization, with a mean blood glucose level of 140 mg/dL and 93.3% of patients maintaining levels within the target range.

This data highlights the dynamic nature of postoperative glycemic control and the importance of continuous monitoring and adjustment of insulin therapy to maintain optimal blood glucose levels,

thereby potentially reducing the risk of surgical site infections in diabetic patients undergoing abdominal surgery.

(Table 6) presents the follow-up data and the incidence of surgical site infections (SSIs) among the 75 diabetic patients at postoperative days 7, 14 and 30. The follow-up was conducted to monitor for signs of SSIs, which were documented and managed according to standard protocols.

On postoperative day 7, 90.7% of the patients showed no signs of SSI, while 9.3% (7 patients) developed an infection. By postoperative day 14, the incidence of SSIs increased slightly, with 13.3% (10 patients) showing signs of infection and 86.7% remaining infection-free. At the final follow-up on postoperative day 30, 16.0% (12 patients) had developed SSIs, while 84.0% did not exhibit any infection signs.

The increasing incidence of SSIs over the 30-day follow-up period underscores the importance of ongoing postoperative monitoring and effective management of glycemic control to reduce infection risk. This table provides crucial insights into the postoperative outcomes of the study cohort and highlights the need for targeted interventions to prevent SSIs in diabetic patients undergoing abdominal surgery.

The results of this prospective cohort study underscore the critical role of postoperative glycemic control in reducing the incidence of surgical site infections (SSIs) in diabetic patients undergoing abdominal surgery. Our findings demonstrate a clear correlation between improved glycemic control postoperatively and a lower incidence of SSIs, aligning with existing literature and contributing valuable insights to this area of surgical care.

The data indicate that maintaining blood glucose levels within the target range of 80-180 mg/dL significantly reduces the risk of SSIs. In our study, 93.3% of patients had their blood glucose levels within the target range by the end of the monitoring period, resulting in a relatively low overall SSI incidence of 16.0% by postoperative day 30. These findings are consistent with previous studies that have highlighted the importance of stringent glycemic control in the perioperative period.

For instance, the study by Umpierrez *et al.* (2011) demonstrated that hyperglycemia is an independent predictor of adverse outcomes, including SSIs, in surgical patients with diabetes. Their research emphasized that better glycemic control leads to improved wound healing and reduced infection rates, which aligns with our observations[7]. Similarly, Duggan *et al.* (2010) reported that patients with well-controlled blood glucose levels had significantly lower rates of postoperative infections compared to those with poorly controlled diabetes[8].

Our findings support the results of Sehgal *et al.* (2011), who found that tight glycemic control in the postoperative period reduced the incidence of SSIs among patients undergoing colorectal surgery. Their study highlighted the benefits of maintaining blood glucose levels below 180 mg/dL, which is consistent with our target range and findings[9]. Additionally, the work by Chase *et al.* (2018) reinforced the notion that achieving normoglycemia postoperatively is crucial for preventing infections and improving overall surgical outcomes[10].

However, it is worth noting that while stringent glycemic control is beneficial, it must be balanced against the risk of hypoglycemia. Hypoglycemia can have serious adverse effects, particularly in the perioperative setting[11]. Therefore, the findings from our study advocate for a balanced approach where blood glucose levels are closely monitored and managed to remain within a safe target range.

The clinical implications of this study are significant. For surgical teams managing diabetic patients, implementing rigorous postoperative glycemic control protocols can be a key strategy in reducing SSIs. This involves regular monitoring of blood glucose levels, timely administration of insulin and appropriate adjustments based on individual patient needs. Our findings suggest that such interventions can lead to better surgical outcomes and reduced healthcare costs associated with prolonged hospital stays and additional treatments for infections.

Future research should focus on larger, multi center trials to validate these findings across diverse patient populations and surgical procedures. Additionally, exploring the impact of different glycemic control protocols and technologies, such as continuous glucose monitoring systems, could further enhance postoperative care for diabetic patients.

CONCLUSIONS

In conclusion, this study provides robust evidence supporting the role of postoperative glycemic control in reducing SSIs among diabetic patients undergoing abdominal surgery. Our findings align with previous research and highlight the importance of maintaining blood glucose levels within a specific target range to improve surgical outcomes. By incorporating these practices into standard postoperative care, healthcare providers can significantly enhance patient safety and recovery.

REFERENCES

1. Martin, E.T., K.S. Kaye, C. Knott, H. Nguyen and M. Santarossa *et al.,* 2015. Diabetes and risk of surgical site infection: A systematic review and meta-analysis. Infec. Control Hosp. Epidemiol., 37: 88-99.

2. Petrosyan, Y., K. Thavorn, M. Maclure, G. Smith and D.I. McIsaac *et al.,* 2019. Long-term health outcomes and health system costs associated with surgical site infections. Ann. Surg., 273: 917-923.
3. Patel, K.L., 2008. Impact of tight glucose control on postoperative infection rates and wound healing in cardiac surgery patients. J. Wound, Ostomy Continence Nurs., 35: 397-404.
4. Rosenberg, C.S., 1990. Wound healing in the patient with diabetes mellitus. Nurs. Clin. North. Am., 25: 247-261.
5. Umpierrez, G.E., S.D. Isaacs, N. Bazargan, X. You, L.M. Thaler and A.E. Kitabchi, 2002. Hyperglycemia: An independent marker of in-hospital mortality in patients with undiagnosed diabetes. J. Clin. Endocrinol. Metab., 87: 978-982.
6. Kao, L.S. and U.R. Phatak, 2013. Glycemic control and prevention of surgical site infection. Surg. Infec., 14: 437-444.
7. Umpierrez, G.E., R. Hellman, M.T. Korytkowski, M. Kosiborod and G.A. Maynard *et al.,* 2012. Management of hyperglycemia in hospitalized patients in non-critical care setting: An endocrine society clinical practice guideline. J. Clin. Endocrinol. Metab., 97: 16-38.
8. Duggan, E.W., K. Carlson and G.E. Umpierrez, 2017. Perioperative hyperglycemia management. Anesthesiology, 126: 547-560.
9. Sehgal, R., A. Berg, R. Figueroa, L.S. Poritz, K.J. McKenna, D.B. Stewart and W.A. Koltun, 2011. Risk factors for surgical site infections after colorectal resection in diabetic patients. J. Am. Coll. Surgeons, 212: 29-34.
10. Chase, J.G., T. Desaive, J. Bohe, M. Cnop and C.D. Block *et al.,* 2018. Improving glycemic control in critically ill patients: Personalized care to mimic the endocrine pancreas. Crit. Care, Vol. 22 .10.1186/s13054-018-2110-1.
11. Sudhakaran, S. and S.R. Surani, 2015. Guidelines for perioperative management of the diabetic patient. Surg. Res. Pract., Vol. 2015 .10.1155/2015/284063