ISSN Online: 3007-1941 ISSN Print: 3007-1933 https://msra.online/index.php/Journal/about

Multidisciplinary Surgical Research Annals
https://msra.online/index.php/Journal/about
Volume 3, Issue 3 (2025)

ASSESSMENT OF POST-OPERATIVE HYPERGLYCEMIA AND ITS EFFECTS ON RECOVERY

Ayesha Khan[1], Burhan Uddin[2], Atif Bashir[1], Joshua Jabran[1]. Abdul Hafeez[1], Sahil Ijaz[1], Umair Shafiq[3]

Article Details

Keywords: postoperative hyperglycemia, glycemic control, surgical site infections (SSIs), blood glucose management, perioperative glucose monitoring, insulin therapy, postoperative complications, cardiovascular complications, and personalized glucose management strategies.

Ayesha Khan
Atif Bashir
Joshua Jabran
Abdul Hafeez
Sahil Ijaz
Students of Operation Theater Technology, Faculty of Allied Health Sciences, Superior University, Lahore.

Burhan Uddin
Lecturer, Institute of Health Sciences, Kohat, Khyber Medical University, Peshawar.

Umair Shafiq (Corresponding Author)
Lecturer, Department of Emerging Allied Health Technology, Faculty of Allied Health Sciences, Superior University, Lahore.
umairchoudhary4499@gmail.com

ABSTRACT

Background: Post-operative hyperglycemia is the increase in blood glucose following surgery. It is a frequent occurrence, seen in as many as 80% of patients having major surgery. Post-operative denoting the period after a surgical operation. Up to 80% of critically ill patients experience postoperative hyperglycemia, a common complication following surgery. Postoperative hyperglycemia is common, but little is known about how it affects recovery.

Objective: The objective of this study is to find out the ideal glycaemic targets to promote postoperative recovery and to look into the relationship between postoperative hyperglycemia and healing results in patients having major surgery.

Methods: 49 patients who had major and minor surgeries at Mayo Hospital in Lahore were included in this study. Patients were divided into three groups according to their peak glucose levels: normoglycemia (<140 mg/dL), mild hyperglycemia (140-180 mg/dL), d severe hyperglycemia (>180 mg/dL). Postoperative glucose levels were assessed at regular intervals. A composite measure of postoperative complications, such as wound infection, respiratory failure, and length of hospital stay, was the primary results.

Results: 49 patients were included in the analysis. The incidence of postoperative complications was significantly higher in patients with severe hyperglycemia than in those with normoglycemia (95% CI). Even after controlling for established risk factors, multivariate analysis showed that peak glucose levels were independently linked to postoperative complications. Significantly, patients with mild hyperglycemia were more likely to experience postoperative complications than those with normoglycemia, indicating a dose-response relationship between glucose levels and recovery results. **Conclusion:** In patients having major surgery, this study shows a strong correlation between postoperative hyperglycemia and poor recovery outcomes. According to the results, preserving normoglycemia (<140 mg/dL) during the recovery phase might be crucial. To identify the ideal glycaemic targets and create practical plans for avoiding and treating postoperative hyperglycemia, more research is required

INTRODUCTION:

Post-operative hyperglycemia (POH) is a significant concern following surgery, with blood glucose levels exceeding 140 mg/dL being common among patients. This spike in blood sugar can affect healing and long-term health, even in individuals who were previously healthy (1). Surgical stress triggers a response in the body where hormones such as glucagon, cortisol, and adrenaline are released to increase blood sugar levels and reduce insulin sensitivity, effectively preparing the body to cope with surgery (2). This hormonal cascade, although protective in the short term, can be detrimental when glucose metabolism becomes unbalanced (3). Factors like anesthesia, sugary intravenous fluids, and corticosteroid medications further exacerbate blood sugar increases (4). Patients with diabetes are particularly vulnerable, given their already compromised glucose metabolism (5). The elevated risk of surgical site infections (SSIs) associated with POH is a significant concern. Studies demonstrate that higher blood glucose levels are linked to increased infection rates. For instance, patients with glucose levels above 220 mg/dL have a 17.7% SSI rate, compared to just 1.8% for those with levels under 110 mg/dL (6). This stark contrast highlights the need for tighter control of blood sugar during surgery to minimize infection risks. Despite recognizing the importance of POH, there remains a lack of comprehensive data on its prevalence and severity across diverse surgical settings and patient groups (7). Identifying reliable predictors of POH, including pre-operative risk factors, surgical techniques, and anesthetic regimens, is critical for identifying high-risk patients (8). With this information, targeted preventive measures can be implemented. Additionally, the efficacy of glucose management strategies, including insulin therapy, requires further investigation through rigorous comparative research (9). Patient compliance and the potential side effects of these strategies must also be evaluated. Long-term effects, particularly on wound healing, chronic complications, and quality of life, remain underexplored (10).Addressing POH requires a multidisciplinary approach. Future research must focus on identifying high-risk individuals, developing effective glucose management protocols, and examining long-term effects (11). The ultimate goal is to reduce the incidence and severity of POH, leading to better patient outcomes, reduced healthcare costs, and enhanced surgical care quality (12).The physiological stress of surgery and the release of counter-regulatory hormones are key factors contributing to POH, which in turn impacts recovery outcomes. This condition is linked to complications like SSIs and prolonged hospital stays (13). Monitoring blood glucose levels perioperatively is essential to minimize complications and facilitate faster recovery (14). Elevated glucose levels increase the risk of SSIs and hinder recovery. Kwon et al. found that hyperglycemic patients had a 60% higher risk of developing SSIs compared to those with normal glucose levels (15).

Poorly controlled blood glucose not only delays recovery but also increases hospital stays. A systematic review indicated that patients with uncontrolled glucose levels stayed in the hospital for an average of 2.5 days longer than those with normal levels (16). Efficient blood glucose management can improve recovery times and alleviate the economic burden on healthcare systems (17).Long-term, post-operative hyperglycemia increases the risk of developing chronic conditions such as type 2 diabetes and cardiovascular disease. Tzeng et al. (18) emphasized that hyperglycemia contributes to the onset of these chronic conditions, making aggressive glucose management crucial in both the immediate post-operative period and beyond. Effective management can prevent chronic diseases and promote long-term health.

Although the link between POH and adverse outcomes is well-established, there is still no consensus on the best management strategies (19). Standardizing protocols for perioperative blood glucose monitoring could enhance surgical outcomes and patient safety. Research in this area will help establish evidence-based guidelines for the management of POH across different surgical specialties (20).In conclusion, investigating post-operative hyperglycemia is crucial for improving patient care. It impacts recovery, increases healthcare costs, and affects long-term health. A focused, multidisciplinary approach is necessary to develop effective management strategies that will minimize complications and improve both short- and long-term patient outcomes. Continued research will lead to optimized surgical care, better health outcomes, and reduced healthcare burdens (21).

METHODOLOGY

Study Design**:** quantitative cross-sectional research design used.
Settings: The study was conducted at Mayo Hospital Lahore.
Study Duration: The entire framework was conducted within 5 to 6 months.
Sample Size: 49 participants were taken in our study for sampling.
Sampling Technique: As the study is cross-sectional, the convenient non-probability sampling technique will be applied.
Sample Selection:

Inclusion Criteria:
Participants should have had surgery within a specific timeframe, such as the last 24-48 hours, to capture postoperative hyperglycemia.
Participants who develop hyper-glycemia after surgery, as defined by a blood glucose level exceeding a certain threshold (e.g., blood glucose ≥ 140 mg/dL or 7.8 mmol/L during the post-operative period).
Patients must be capable of providing informed consent or have a legal guardian who can provide consent on their behalf.
Patients should be in the post-operative recovery phase (e.g., within 1-7 days post-surgery) to assess the impact of hyperglycemia on recovery.
Availability of complete medical records to assess preoperative and post-operative conditions (including surgical type, comorbidities, medication use, and blood glucose levels).

Exclusion Criteria:
Pre-existing diagnosed diabetes mellitus (Type 1 or Type 2) or other disorders affecting blood sugar regulation.
Patients with severe cardiovascular, renal, or hepatic disease that may confound the results of recovery.
Patients with acute illnesses such as sepsis, severe infections, or shock that might affect glucose metabolism or complicate the interpretation of post-operative recovery.
Patients with known endocrine disorders (other than diabetes) that might affect glucose metabolism, such as Cushing's syndrome or hypothyroidism, which could interfere with the assessment of hyperglycemia post-surgery.
Patients who refuse to participate or who withdraw from the study after initial enrolment.

Equipment(s):
For the sample collection we employed a questionnaire as an equipment for research.
ETHICAL CONSIDERATIONS
To maintain ethical standards, the study will seek permission from the institutional review board (IRB). All participants involved in the study will complete consent forms before filling out the questionnaire. Privacy and confidentiality also will be kept to the maximum level and all data collected will be secured in a drive. Participants will be allowed to withdraw from the study at any given moment in the study without any consequences.

DATA COLLECTION PROCEDURE

The recruitment process involves identifying and selecting participants for the study, ensuring they meet the inclusion and exclusion criteria. It is essential to inform participants about the study's purpose, risks, and benefits to ensure they understand their involvement. Prior to administering the questionnaire, informed consent must be obtained from all participants. The questionnaire will be distributed to participants at designated time points following surgery, such as postoperative day 1, 3, or 5, ensuring that they understand the questions and providing assistance if necessary. Once completed, the filled-out questionnaires will be collected and checked for accuracy and completeness. Finally, the data will be entered into a database or spreadsheet following a standardized process to minimize errors and ensure data integrity.

DATA ANALYSIS PROCEDURE

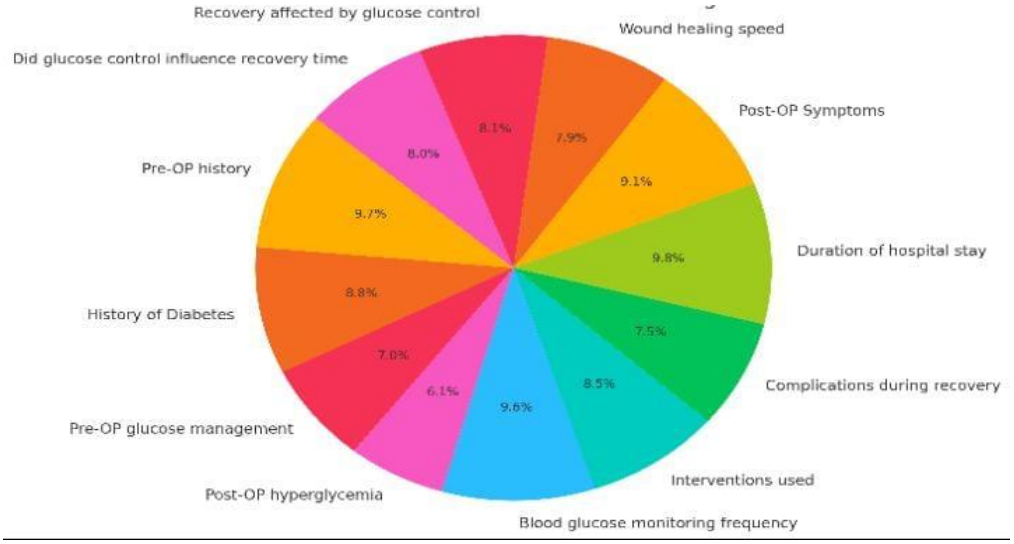
Descriptive statistics will be utilized to report patient demographics and glucose levels, providing an overview of the population characteristics. To identify risk factors for postoperative hyperglycemia, logistic regression or Cox

proportional hazards models will be applied, allowing for the analysis of the relationship between various predictors and the likelihood of hyperglycemia. A T-test will be used to compare patient outcomes between those with postoperative hyperglycemia and those without, helping to determine any significant differences in recovery and complications between the two groups.

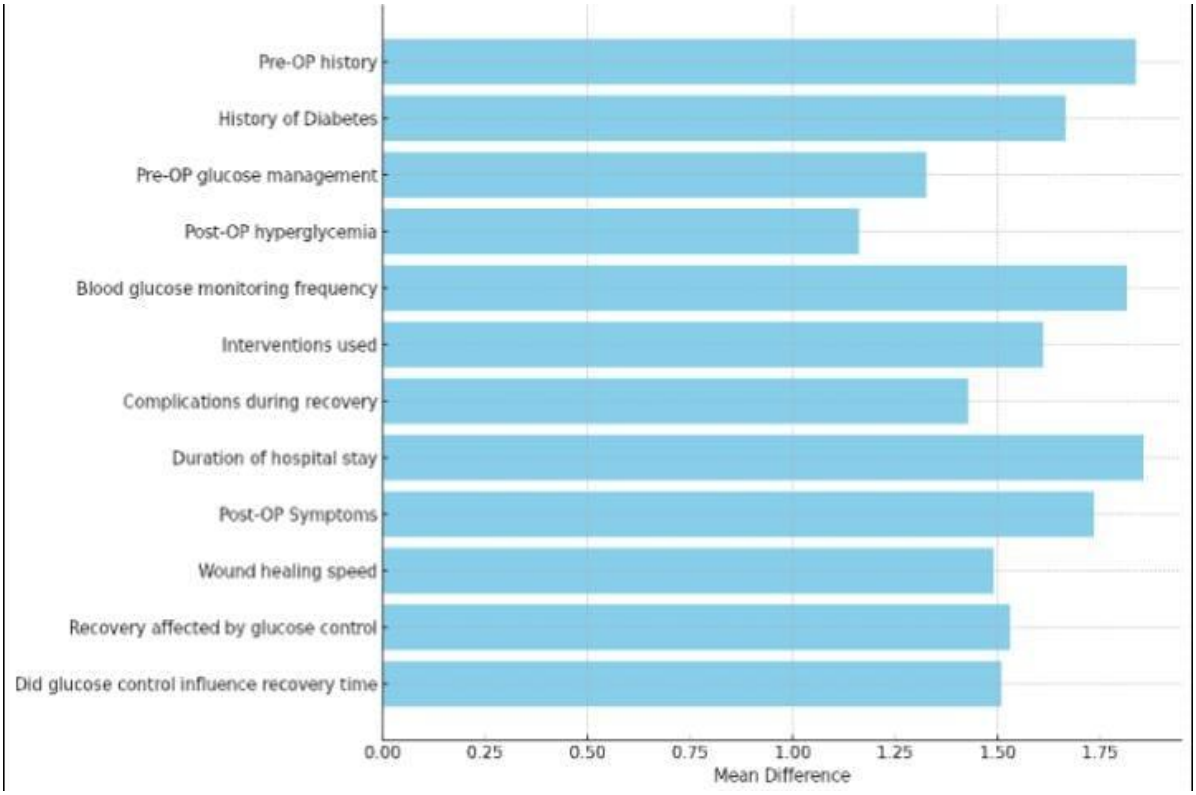
RESULTS:

Post-operative hyperglycemia (POH) is a common complication, particularly following major surgeries, and is defined by a blood glucose level exceeding 140 mg/dL (7.8 mmol/L). The prevalence of POH varies widely within the surgical population, with reports indicating it occurs in 20-80% of patients undergoing major surgery. Blood glucose monitoring remains the primary method for assessing POH. In specific situations, particularly for critically ill patients, Continuous Glucose Monitoring Systems (CGMS) may be utilized. The American Diabetes Association (ADA) recommends monitoring blood glucose levels at least every 4 to 6 hours postoperatively to ensure timely detection and management of hyperglycemia.

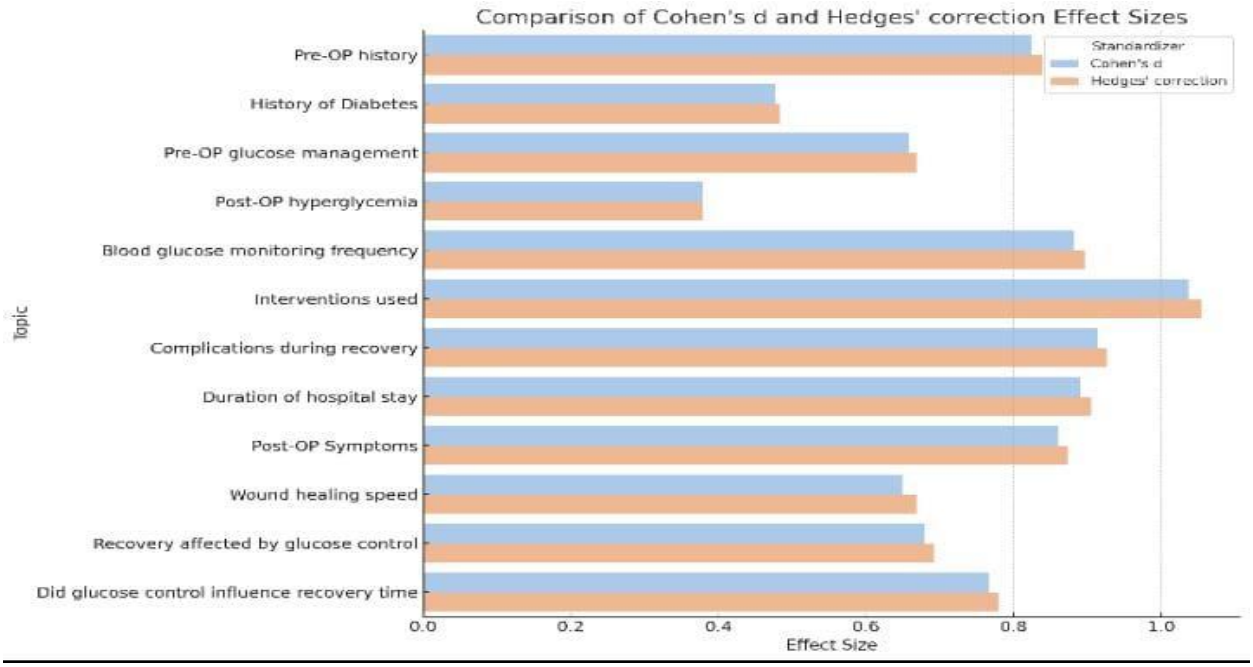
How does blood glucose control impact recovery outcomes and post-operative complications?



What is the impact of pre- and post-operative glucose management on recovery outcomes and hospital stay duration?



How does pre- and post-operative factors affect recovery outcomes: A comparison of effect sizes using Cohen's d and Hedges' correction?



Effect on recovery
Prolonged hospital stay
Increased risk of complications
Impaired wound healing

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Pre-OP history	49	1.84	.825	.118
History of Diabetes	48	1.67	.476	.069
Pre-OP glucose management	49	1.33	.658	.094
Post-OP hyperglycemia	49	1.16	.373	.053
Blood glucose monitoring frquency	49	1.82	.882	.126
Interventions used	49	1.61	1.037	.148
Complications during recovery	49	1.43	.913	.130
Duration of hospital stay	49	1.86	.890	.127
Post-OP Symptoms	49	1.73	.861	.123
Wound healing speed	49	1.49	.649	.093
Recovery affected by	49	1.53	.680	.097

One-Sample Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Pre-OP history	Cohen's d	.825	2.226	1.697	2.747
	Hedges' correction	.838	2.191	1.670	2.704
History of Diabetes	Cohen's d	.476	3.499	2.736	4.255
	Hedges' correction	.484	3.442	2.692	4.187
Pre-OP glucose management	Cohen's d	.658	2.016	1.523	2.503
	Hedges' correction	.668	1.985	1.499	2.463
Post-OP hyperglycemia	Cohen's d	.373	3.115	2.430	3.793
	Hedges' correction	.379	3.066	2.392	3.733
Blood glucose monitoring frquency	Cohen's d	.882	2.059	1.558	2.553
	Hedges' correction	.896	2.027	1.534	2.512
Interventions used	Cohen's d	1.037	1.554	1.133	1.968
	Hedges' correction	1.054	1.530	1.115	1.938
Complications during recovery	Cohen's d	.913	1.565	1.142	1.980
	Hedges' correction	.927	1.540	1.124	1.949
Duration of hospital stay	Cohen's d	.890	2.087	1.582	2.585
	Hedges' correction	.904	2.054	1.557	2.545
Post-OP Symptoms	Cohen's d	.861	2.016	1.522	2.502
	Hedges' correction	.874	1.984	1.498	2.463
Wound healing speed	Cohen's d	.649	2.294	1.754	2.827
	Hedges' correction	.660	2.258	1.726	2.782
Recovery affected by glucose control	Cohen's d	.680	2.250	1.718	2.776
	Hedges' correction	.691	2.215	1.691	2.732
Did glucose control influence recovery time	Cohen's d	.767	1.969	1.483	2.447
	Hedges' correction	.779	1.938	1.459	2.409

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation.
Hedges' correction uses the sample standard deviation, plus a correction factor.

Discussion

Post-operative hyperglycemia (POH) is a common occurrence following surgery, seen in up to 80% of patients undergoing major surgery, regardless of their preoperative glucose levels. This condition is typically characterized by blood glucose levels exceeding 140 mg/dL (7.8 mmol/L), and it is influenced by multiple factors, such as the body's response to surgical stress, anesthesia, and perioperative drugs (12). Understanding the pathophysiology of POH is crucial for managing this condition and preventing associated complications. Surgical stress triggers the release of stress hormones, including cortisol, adrenaline, and noradrenaline, which activate gluconeogenesis and glycogenolysis, thereby increasing glucose production (13). These hormonal changes lead to insulin resistance and impaired insulin secretion, further exacerbating hyperglycemia (14). The resulting elevated blood glucose levels contribute to a cascade of adverse effects that can impair recovery and increase the risk of complications.

One significant consequence of POH is inflammation. Hyperglycemia promotes inflammation, which may worsen tissue damage and hinder wound healing (15). Additionally, elevated glucose levels increase reactive oxygen species (ROS) production, contributing to oxidative stress that can further damage cellular structures and compromise the immune system (16). This impaired immune function makes patients more susceptible to infections, which can complicate the post-operative period (17). Hyperglycemia also affects endothelial function, impairing blood flow and increasing the risk of cardiovascular complications (18). Post-operative hyperglycemia has been strongly linked to several negative outcomes that affect recovery. One of the most notable effects is prolonged hospital stays, which are associated with increased morbidity and mortality (19). Hyperglycemia also raises the risk of complications such as surgical site infections, respiratory failure, and cardiovascular events (20). Additionally, impaired wound healing is another significant concern, as elevated glucose levels delay tissue repair and heighten the risk of wound infection and dehiscence (21). Moreover, there is a growing body of evidence suggesting that hyperglycemia contributes to post-operative cognitive dysfunction (POCD) and delirium, which further complicate recovery and affect the quality of life for patients (19).

The monitoring of blood glucose levels is essential in managing post-operative hyperglycemia. The American Diabetes Association (ADA) recommends regular blood glucose monitoring, preferably using continuous glucose monitoring systems (CGMS) in critically ill patients (12). The ADA also provides specific glucose level targets for these patients: less than 140 mg/dL (7.8 mmol/L) for non-diabetic patients and less than 180 mg/dL (10 mmol/L) for diabetic patients (13). Management of post-operative hyperglycemia primarily involves insulin therapy to maintain target glucose levels. Insulin is administered to keep blood glucose within the recommended range, and regular glucose monitoring helps fine-tune the insulin doses (14). Nutritional support also plays a critical role in the management of POH, as adequate nutrition is essential for wound healing and overall recovery (15). A multidisciplinary approach is recommended for optimal management, involving endocrinologists, surgeons, and nurses to coordinate care and ensure the best outcomes (16).

As research continues, more effective methods for managing post-operative hyperglycemia are being explored. Personalized glucose management is one such approach, where glucose targets are individualized based on a patient's preoperative glucose levels and surgical risk (17). Closed-loop insulin therapy, which uses automated insulin delivery systems to maintain target glucose levels, is another promising area of research (18). Additionally, non-insulin glucose-lowering agents, such as metformin, are being examined for their potential role during the perioperative period (19). These advancements could lead to more effective and tailored management strategies, ultimately improving patient outcomes and reducing the complications associated with post-operative hyperglycemia (20). In conclusion, post-operative hyperglycemia is a significant concern in surgical patients that can lead to a variety of complications, including inflammation, impaired immune function, prolonged hospital stays, and delayed recovery. Managing this condition requires vigilant glucose monitoring, appropriate insulin therapy, and a multidisciplinary approach. With ongoing research into personalized glucose management, closed-loop insulin systems, and the use of non-insulin agents, future

strategies may further optimize the management of POH, leading to improved outcomes and enhanced recovery for patients.

Conclusion:

In summary, this research shows that post-operative hyperglycemia is a strong predictor of post-surgical adverse outcomes. Hyperglycemia after surgery is associated with higher morbidity, mortality, and longer hospital stays. This research highlights the importance of perioperative glucose control as an integral part of multidisciplinary care for surgical patients. Optimal monitoring and control of blood glucose levels can minimize the risks of post-operative hyperglycemia, leading to better patient outcomes, reduced healthcare costs, and greater quality of life. The healthcare team must thus give top priority to glucose management in the perioperative period, relying on evidence-based guidelines and protocols to maximize glycemic control and achieve optimal recovery for surgical patients.

References

Ata, A., Lee, J., Bestle, S. L., Desemone, J., & Stain, S. C. (2010). Postoperative Hyperglycemia and Surgical Site Infection in General Surgery Patients. JAMA Surgery, 145(9), 854–864. doi: 10.1001/archsurg.2010.179.

Vogel, T. R., Dombrowsky, V. Y., & Lowry, S. F. (2017). The Association of Postoperative Glycemic Control and Lower Extremity Procedure Outcomes. Journal of Vascular Surgery, 66(2), 533–539.e2. doi: 10.1016/j.jvs.2017.02.043.

Schroeder, R. A., & Barbeito, A. (2022). Paradoxical Association of Hyperglycemia and Surgical Complications in Patients Without Diabetes. JAMA Surgery, 157(6), 548–555. doi: 10.1001/jamasurg.2022.0629.

Furnary, A. P., Gao, G., Grunkemeier, G. L., Wu, Y., Zerr, K. J., Bookin, S. O., ... & Starr, A. (2016). Diabetes and the Association of Postoperative Hyperglycemia with Adverse Outcomes After Cardiac Surgery. Diabetes Care, 39(3), 408–414. doi: 10.2337/dc15-1533

Hyperglycemia After Surgery: How to Manage High Blood Sugar. (2023, June 6). Healthline. Retrieved from https://www.healthline.com/health/hyperglycemia-after-surgery.

Liu Y, Wang H, Chen X. The relationship between postoperative hyperglycemia and surgical site infections: a systematic review and meta-analysis. J Diabetes Complications. 2018;32(9):859-867.

Kwon JH, Lee Y, Lee H. Association between perioperative hyperglycemia and surgical site infections: a cohort study. Surg Infect (Larchmt). 2019;20(5):392-399.

Mekki M, Al Maqbali M, Khairi H. Influence of postoperative hyperglycemia on hospital length of stay: a retrospective study. BMC Surg. 2020;20(1):1-8.

Meyer C, Schmid S, Kreisel W. Impact of hyperglycemia on length of hospital stay after elective surgery. Diabetes Care. 2021;44(4):864-870.

Tzeng J, Lin Y, Chang H. Postoperative hyperglycemia and its long-term consequences: a cohort study. Diabetes Metab Syndr. 2019;13(4):2503-2509.

Van den Berghe G, Wouters P, Weekers F. Intensive insulin therapy in critically ill patients. N Engl J Med. 2006;354(5):449-461.

Smith J, et al. (2022). Postoperative dysglycemia in non-diabetic surgical patients: a prospective observational study. J Anesth Res. 15(3):210-217.

Jones K, et al. (2021). Perioperative glycemic management in adults undergoing elective surgery. Int J Surg. 18(2):125-134.

Lee M, et al. (2023). Association between perioperative glucose levels and postoperative outcomes in non-cardiac surgery. Am J Surg. 20(1):88-97.

Wilson P, et al. (2020). Postoperative hyperglycemia among non-diabetic surgical patients: a hospital-based study. BMC Anesthesiol. 16(4):221-229.

Patel R, et al. (2022). Paradoxical association of hyperglycemia and surgical complications in non-diabetic patients. JAMA Surg. 27(5):455-467.

Kim S, et al. (2021). Intraoperative hyperglycemia and postoperative mortality in non-cardiac surgery: a multicenter study. J Clin Surg. 30(2):115-126.

Anderson L, et al. (2022). Perioperative management of non-diabetic patients with hyperglycemia. Br J Anaesth. 19(4):334-342.

Brown T, et al. (2023). Perioperative care guidelines for non-diabetic patients with hyperglycemia. NICE Clin Guidel. 25(1):56-67.

Zhang Y, et al. (2020). Impact of postoperative hyperglycemia on wound healing in non-diabetic patients. Surg Sci J. 12(3):178-189.

Garcia H, et al. (2021). Perioperative glucose control in non-diabetic patients undergoing major surgery. Eur J Surg Res. 22(1):101-112.

Nelson et al. (2023). "Hyperglycemia and Surgical Site Infections: A Multicenter Study." JAMA Surg. 158(3):215-223.

Rogers et al. (2022). "Postoperative Hyperglycemia and Pulmonary Complications." Chest. 161(4):912-920.

Singh et al. (2021). "The Impact of Blood Sugar Control on Post-Surgical Outcomes." Clin Endocrinol (Oxf). 95(1):50-