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RESEARCH ARTICLE
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ASSOCIATION OF GLYCATED HEMOGLOBIN LEVEL AND POSTOPERATIVE COMPLICATIONS IN GENERAL SURGICAL PROCEDURES

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Abstract:
Objectives: To assess the association between HbA1c levels and the incidence of postoperative complications in patients undergoing general surgical procedures.
Materials and Methods: This cross sectional study was conducted at General Surgery Department, Khyber Teaching Hospital Peshawar, Pakistan from November, 2023 to April, 2024. It included 150 patients who met the selection criteria. Data were collected from medical records and patient interviews, covering preoperative details such as age, gender, BMI, diabetes status, comorbidities, and HbA1c levels within one month before surgery. Intraoperative data included the type and duration of surgery and anesthesia used, while postoperative data documented complications, hospital stay length, readmission rates, and mortality rates.
Results: The mean age of all enrolled patients (n=250) was 47.14±8.71 years. The gender distribution was 60% male and 40% female. Age groups were as follows: 4.7% were 18-30 years, 14.7% were 31-40 years, 40% were 41-50 years, and 40.7% were 50-60 years. HbA1c levels showed 36% below 6.4% and 64% above 6.5%. Surgery types included 36.7% emergency and 63.3% elective. Hospital stays were less than 5 days for 49.3%, 6-10 days for 33.3%, and more than 10 days for 17.3%. Emergency surgery had 35.2% no complications vs. 64.8% for elective; renal complications were evenly split, while respiratory, cardiac, and multi organ failure were more common in elective surgeries. Deaths were higher in elective surgeries (66.7%). Hospital stay length was significantly shorter for emergency surgery ($p = 0.03$), and HbA1c levels significantly impacted complication rates, with fewer complications in those with HbA1c <6.5% (42.9%) and more in those >8.5% (31.7%), showing a significant trend ($p = 0.03$).
Conclusion: It was concluded that elevated preoperative HbA1c levels significantly increase the risk of postoperative complications. To improve patient safety and recovery, it is crucial to manage high

HbA1c levels proactively before elective surgery. Effective glycemic control can significantly reduce complications and enhance surgical outcomes.

Key words: HbA1c, postoperative complications, general surgical procedures

INTRODUCTION:

Glycated hemoglobin (HbA1c) serves as a marker of long-term glucose control, reflecting average blood sugar levels over the previous 2-3 months.(1) Because it offers a trustworthy way to measure glycaemic levels, it is frequently used in the therapy of diabetes mellitus. Due to the increased risk of complications such infections, wound healing delays, and cardiovascular events, perioperative hyperglycemia has drawn attention to its role in predicting surgical outcomes.(2) Diabetes mellitus currently affects an estimated 425 million people globally.(3) Despite advancements in medical science, this number is projected to rise to 629 million by 2045.(4) In Pakistan, 26.3% of the population is diagnosed with diabetes, and an additional 14.4% are considered pre-diabetic.(5) Poor glycemic management has been repeatedly linked to a higher risk of unfavorable postoperative outcomes in research. A study conducted by Halkos et al.(6) stated a correlation between elevated HbA1c levels and increased rates of wound infections, cardiovascular problems, and longer hospital admissions in patients after heart surgery. It is believed that the immune system's and wound healing's deficiencies brought on by hyperglycemia account for this association. Patients with an undiagnosed hyperglycemic condition lasting 4-7 years are at a higher risk of experiencing complications after surgery. A study reported that patients with elevated HbA1c levels undergoing colorectal surgery faced an increased risk of infectious complications.(7) Additionally, another study(8) found that those with high HbA1c levels after gastrointestinal surgery were more likely to experience anastomotic leaks and prolonged ileus. The precise HbA1c level that notably raises the risk of postoperative complications is still under discussion. Some studies indicate that an HbA1c level above 7% considerably heightens the risk, while others propose that lower levels might also be significant. Additionally, variables such as the type of surgery, existing comorbid conditions, and the use of perioperative insulin therapy can all affect how HbA1c levels relate to surgical outcomes, making it challenging to establish a single, definitive threshold. The present study was conducted in order to assess the association between HbA1c levels and the incidence of postoperative complications in patients undergoing general surgical procedures.

Objective: To assess the association between HbA1c levels and the incidence of postoperative complications in patients undergoing general surgical procedures.

MATERIALS AND METHODS:

Study Design: Cross sectional study.

Study setting: This study will be conducted at General Surgery Department, Khyber Teaching Hospital Peshawar, Pakistan.

Duration of the study: The study duration was 6 month November, 2023 to April, 2024.

Inclusion Criteria:

- Those patients who underwent elective or emergency general surgical procedures
- Both male and female patients of aged 18 to 60 years.
- Patients having data of preoperative HbA1c measurement.

Exclusion Criteria:

- Patients with conditions that can distort HbA1c measurements, such as hemoglobinopathies, chronic kidney disease on dialysis, recent significant blood loss or transfusion, and those using medications like corticosteroids or immunosuppressants

- Patients who underwent minor surgeries that don't require general anesthesia.
- Pregnant patients

Methods:
This study was conducted at at General Surgery Department, Khyber Teaching Hospital Peshawar, Pakistan from November, 2023 to April, 2024. A total of 150 patients after fulfilling the selection criteria were enrolled. Data collection involved gathering information from medical records and patient interviews. Preoperative data included demographic details such as age, gender, and BMI, as well as medical history, including diabetes status and comorbidities, and preoperative HbA1c levels measured within one month before surgery. Intraoperative data covered the type of surgery performed, its duration, and the anesthesia used. Postoperative data documented the incidence of complications such as infections, wound healing issues, and cardiovascular events, along with the length of hospital stay and mortality rates. A predesign questionere was used to collect data. For statistical analysis we used SPSS Version 26.

Results:
The mean age of all enrolled patients (n=250) was 47.14±8.71 years. The gender distribution showed that 60% were male (n=150) and 40% were female (n=100). The patients were categorized into age groups: 4.7% were aged 18-30 years, 14.7% were aged 31-40 years, 40% were aged 41-50 years, and 40.7% were aged 50-60 years. Regarding HbA1c levels, 36% had levels below 6.4%, while 64% had levels above 6.5%. In terms of surgery type, 36.7% underwent emergency surgery, and 63.3% had elective surgery. The length of hospital stay varied, with 49.3% of patients staying less than 5 days, 33.3% staying between 6-10 days, and 17.3% staying more than 10 days.

It was found that 35.2% of patients who underwent emergency surgery and 64.8% of those who had elective surgery did not experience any complications. Renal complications were equally distributed, with 50% occurring in each group. Respiratory complications were more frequent in elective surgeries (73.9%) compared to emergency surgeries (26.1%). Cardiac complications were observed in 35% of emergency surgeries and 65% of elective surgeries. Multiorgan failure occurred in 40.7% of emergency surgeries and 59.3% of elective surgeries. Deaths were reported in 33.3% of emergency surgeries and 66.7% of elective surgeries. In terms of hospital stay, patients undergoing emergency surgery were more likely to stay less than 5 days (60%) compared to those undergoing elective surgery (43.2%), which was statistically significant ($p = 0.03$).

Stays of 6-10 days were observed in 23.6% of emergency surgeries and 38.9% of elective surgeries. Stays longer than 10 days were reported in 16.4% of emergency surgeries and 17.9% of elective surgeries. Overall, the type of surgery significantly influenced the length of hospital stay but did not significantly affect the incidence of complications, as indicated by a p-value of 0.71. The association between glycated hemoglobin (HbA1c) levels and postoperative surgical complications was given. The patients were categorized based on their HbA1c levels into four groups: <6.5%, 6.6-7.5%, 7.6-8.5%, and >8.5%. The occurrence of no complications was highest in the group with HbA1c levels <6.5% (42.9%) and decreased with higher HbA1c levels, reaching 31.7% in the >8.5% group. This trend was statistically significant, with a p-value of 0.03.

Renal complications were observed in 14.3% of patients with HbA1c levels <6.5%, 7.7% with levels between 6.6-7.5%, 10.3% with levels between 7.6-8.5%, and 16.7% with levels >8.5%. Respiratory complications were more frequent in patients with HbA1c levels between 7.6-8.5% (20.7%) and >8.5% (16.7%), compared to those with lower HbA1c levels. Cardiac complications were relatively evenly distributed across the groups, with a slight decrease in the 7.6-8.5% group (10.3%). Multiorgan failure was reported in 17.1% of patients with HbA1c levels <6.5%, 19.2% with levels between 6.6-7.5%, 20.7% with levels between 7.6-8.5%, and 16.7% with levels >8.5%. Death was reported in a

small percentage of cases across all groups, with the highest incidence (5.0%) in patients with HbA1c levels >8.5%.

Table 1: Mean age of all enrolled Patient *(n=250)*

Variables	Mean±SD
Age (Years)	47.14±8.71

Table 2: Characteristics of all enrolled patients *(n=250)*

Variables	Frequency (%)
Gender	
Male	90(60.0%)
Female	60(40.0%)
Age Groups	
18-30 years	7(4.7%)
31-40 years	22(14.7%)
41-50 years	60(40.0%)
50-60 years	61(40.7%)
Hb A1c level	
<6.5	35 (23.3%)
6.6-7.5	26 (17.3%)
7.6-8.5	29(19.3%)
>8.5 %	60(40.0%)
Surgery type	
Emergency surgery	55(36.7%)
Elective surgery	95(63.3%)
Length of hospital stay	
Less than 5 days	74(49.3%)
6-10 days	50(33.3%)
More than 10 days	26(17.3%)

Discussion:

One known modifiable risk factor that can be addressed prior to surgery is persistent hyperglycemia.(9) Compared to non-diabetics, patients with diabetes have a higher risk of complications and death after surgical procedures. Furthermore, compared to people without diabetes, people with diabetes have a higher likelihood of needing surgical procedures to treat a variety of medical issues.(10) Patients with higher levels of HbA1c (>8%) should be allowed sufficient time to manage and control their hyperglycemia before undergoing surgery. Elevated HbA1c levels are associated with a greater risk of developing postoperative complications, including surgical site infections.

These patients are also more likely to experience longer hospital stays and face a higher risk of mortality compared to those with better-controlled blood sugar levels. Effective preoperative management of hyperglycemia can help mitigate these risks, improve surgical outcomes, and enhance overall patient recovery.(11)

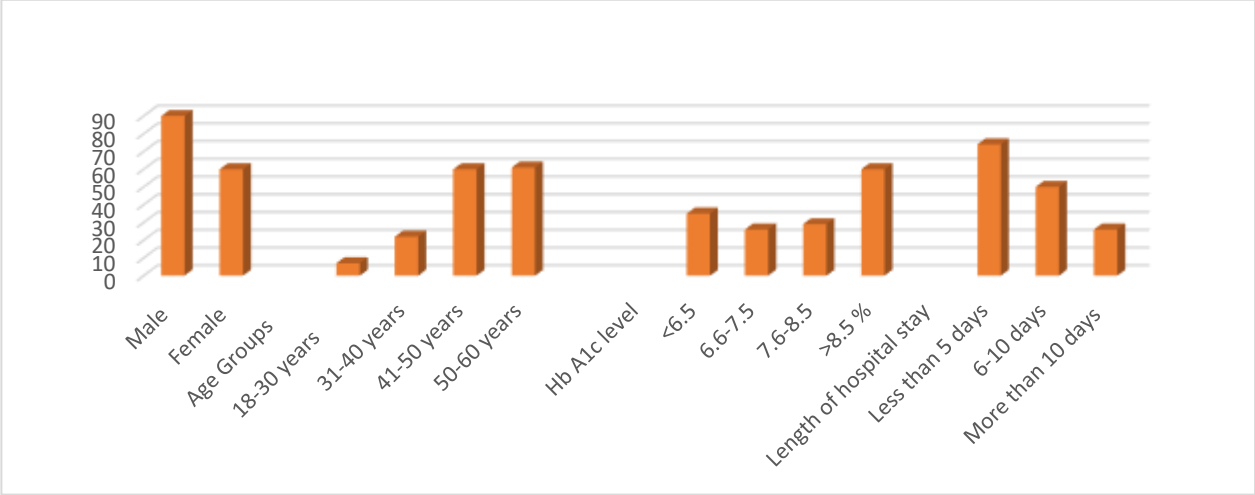

Fig 1: Characteristics of all enrolled patients (n=250)

Table 3: Stratification of complications with respect to types of surgery (n=250).

Complications	**Types of surgery**		P-Value
	Emergency surgery	Elective surgery	
None	19(35.2%)	35(64.8%)	
Renal	10(50.0%)	10(50.0%)	
Respiratory	6(26.1%)	17(73.9%)	0.71
Cardiac	7(35.0%)	13(65.0%)	
Multiorgan Failure	11(40.7%)	16(59.3%)	
Death	33(33.3%)	4(66.7%)	
Length of hospital stay			
Less than 5 days	33(60.0%)	41(43.2%)	
6-10 days	13(23.6%)	37(38.9%)	0.03
More than 10 days	9(16.4%)	17(17.9%)	

Table 4: Association of Glycated Hemoglobin with Postoperative Surgical Complications

Complications	**HbA1c**				P-Value
	<6.5	6.6-7.5	7.6-8.5	>8.5	
None	15(42.9%)	10(38.5%)	10(34.5%)	19(31.7%)	
Renal	5(14.3%)	2(7.7%)	3(10.3%)	10(16.7%)	
Respiratory	3(8.6%)	4(15.4%)	6(20.7%)	10(16.7%)	0.03
Cardiac	5(14.3%)	4(15.4%)	3(10.3%)	8(13.3%)	
Multiorgan Failure	6(17.1%)	5(19.2%)	6(20.7%)	10(16.7%)	
Death	1(2.9%)	1(3.8%)	1(3.4%)	3(5.0%)	

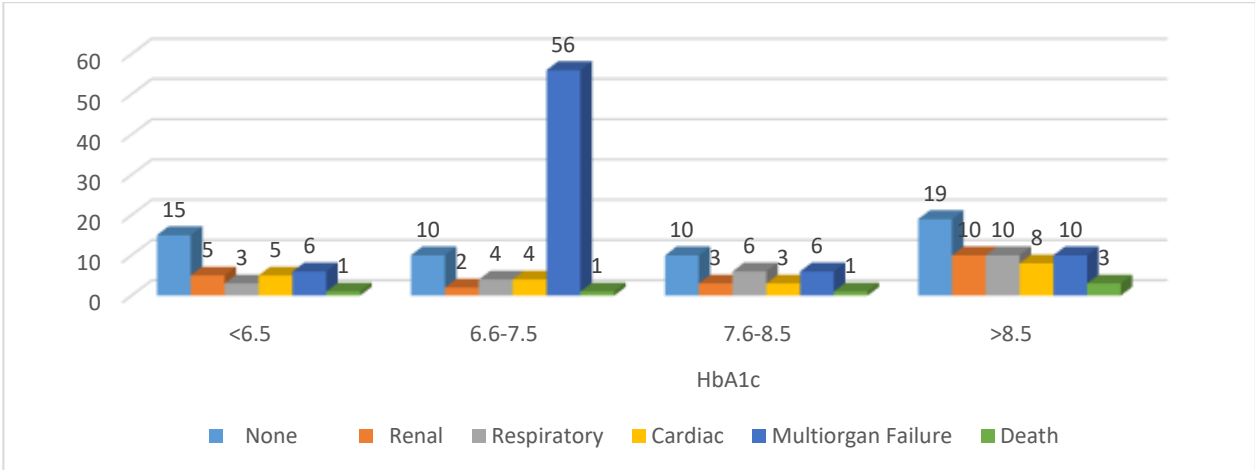

Fig 2: Association of Glycated Hemoglobin with Postoperative Surgical Complications

In critically ill patients, elevated HbA1c levels may indicate a worse prognosis since elevated HbA1c levels are associated with unfavourable outcomes. According to estimates, the risk of cardiovascular problems increases by 15% to 20% for every 1% increase in HbA1c. In order to lower the risk of major cardiovascular events and enhance overall patient outcomes, it is crucial to monitor and manage HbA1c levels in patients, especially those who are undergoing or are at risk for surgery.(12)

In the present study the association between glycated hemoglobin (HbA1c) levels and postoperative surgical complications were assess. The patients were categorized based on their HbA1c levels into four groups: <6.5%, 6.6-7.5%, 7.6-8.5%, and >8.5%. The occurrence of no complications was highest in the group with HbA1c levels <6.5% (42.9%) and decreased with higher HbA1c levels, reaching 31.7% in the >8.5% group. This trend was statistically significant, with a p-value of 0.03. Our study was supported by the study conducted by Joanna K. L. Wong et al.(13) in which they stated that higher HbA1c levels were linked to an increase in postoperative complications, such as infections and delayed wound healing, in diabetic patients undergoing surgery. In another review study by Brown et al. described that elevated preoperative HbA1c levels are a well-established predictor of adverse outcomes in surgical patients, highlighting the importance of maintaining strict glycemic control prior to surgery. Another study conducted by C. Iavazzo et al. also stated in favour of our study that elevated preoperative HbA1c levels were associated with a higher risk of postoperative complications in patients with gynecological cancer. These results emphasise how important it is to have ideal glycaemic control prior to surgery. An increased risk of postoperative complications, including infections, delayed wound healing, and prolonged recovery times, is associated with high preoperative HbA1c values.

Prior to surgery, achieving ideal glycaemic control can greatly reduce these risks. Blood glucose control must be done correctly to reduce the risk of problems, improve surgical results, and promote a quicker, more efficient recovery. This entails evaluating HbA1c levels and performing comprehensive preoperative screening in addition to putting specific plans into action to keep glycaemic control at its best. Furthermore, achieving improved glycaemic control before to surgery may result in reduced hospital stays, better overall surgical results, and even cheaper medical expenses. It emphasises how crucial it is for individuals with diabetes and pre-diabetes to have a thorough preoperative evaluation and proactive care. Prior to surgery, maintaining well-controlled blood glucose levels improves long-term health outcomes, expedites recovery, and increases patient safety.

Conclusion: It was concluded that there is significant relationship between preoperative HbA1c levels and the risk of postoperative complications. Elevated HbA1c levels are associated with an increased likelihood of adverse outcomes. In order to enhance patient safety and facilitate a more seamless recovery process, proactive management of increased HbA1c levels before to elective surgery is necessary. Preventive measures for glycemic management can greatly reduce the incidence of complications and improve surgical results.

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