Correlation of Glycated Hemoglobin With Postoperative Surgical Complications

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ABSTRACT

Objective — *To find out the association of glycated hemoglobin level and postoperative complications in general surgical procedures.*

Study design — *Observational cross-sectional study.*

Place & Duration of study — *Surgical Unit II, Bolan University of Medical and Health Sciences Quetta, from January 2019 to December 2019.*

Methodology — *This study was conducted on 163 diabetic patients. Purposive sampling was done for including study subjects. The study variables were designed to observe primary and secondary outcomes. Patients were followed for 8 weeks. The mortality was recorded within 30 days of the procedure. The results were analyzed on SPSS software version 20.* Chi-Square test used to determine the significance. *P-values < 0.05 were considered statistically significant.*

Results — *Total 1756 patients were admitted for elective and emergency surgical procedures. Out of these 194 (11.04%) patients found diabetic and 163 fulfilled the inclusion criteria for the observation. The mean age of patients was 46.65 + 12.81 year. Male to female ratio was 1.4:1. Majority of the patients had HbA1c >8.5%. Sixty-nine (42.3%) patients underwent emergency surgery and elective surgery done in 94 (57.7%) cases. Fifty-four (33.1%) patients developed superficial surgical site infection (SSSI), and 20 (12.3%) developed deep surgical site infection (DSSI). Respiratory complications were observed in 21 (12.9%), renal in 18 (11%), cardiac in 11 (6.7%) and multiorgan failure in 9.2% patients. Overall mortality was 2.5%.*

Conclusion — *HbA1c is a useful modifiable independent risk factor for general surgical procedures and especially if found raised before elective surgery can be addressed to reduce the chances of complications.*

Key words — *HbA1c, Diabetes Mellitus, Surgical outcomes, Predictive value.*

INTRODUCTION:

Diabetes mellitus is estimated to affect 425 million people. Despite the innovations in medical sciences it is predicted to reach a number of 629 million in year 2045.[1] A total of 26.3% Pakistani population is diabetic, while 14.4% are pre-diabetics.[2,3] Meo et al reported 11.7% prevalence of diabetes mellitus,[4] while in a recent large scale study it was 16.98% and pre-diabetic 10.91%.[5] Review of literature revealed that newly diagnosed patients with diabetes mellitus and poorly controlled hyperglycemia are more prone to develop vascular complications.[6] However there is well known association of hyperglycemia with postoperative morbidity and mortality.[7,8]

Patients with prolonged undiagnosed hyperglycemic state of 4-7 years are more prone to develop postoperative complications.[9] Preoperative glycemic control merely is not a good indicator to predict operative morbidity. Yong et al in their study revealed 33% of elderly patients admitted for surgery were diabetic.[10] In our setup majority patients are unaware

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of their disease burden and diagnosed on routine preoperative work up. Glycated hemoglobin (HbA1c) is currently a recognized biomarker for diagnosis of diabetes mellitus, determination of glycemic control, compliance to medical therapy, as well as for prediction of postoperative complications.[10,11] High level of HbA1c is known to adversely affect surgical outcome, but literature provides conflicting results.[10] The present study was designed to observe the association of high level of HbA1c with surgical outcome in our setup.

METHODOLOGY:

This cross sectional prospective observational study was conducted on indoor patients admitted in Surgical Unit II at Sandeman Provincial Teaching Hospital Quetta, from January 2019 to December 2019. The sample size was determined by purposive sampling. The study was approved by the hospital ethics committee. Informed consent was obtained from patients. The inclusion criteria were known diabetic patients and those found hyperglycemic at the time of preoperative screening. Patients having serum glucose level of more than 48 mmol/mol and/or HbA1c > 6.5% were considered to be diabetic. The exclusion criteria were patients with other co-morbid like anemia, history of recent blood transfusion, renal and cardiac failure. Pregnant women and those with the history of recent child birth were also excluded.

The study variables were age, gender, complete blood count, serum glucose, electrolytes, urea and creatinine level, HbA1c, American Society of Anesthesiologist (ASA) criteria, type of surgery, (elective or emergency), type of wound (clean, contaminated and dirty), length of hospital stay and mortality. Patients were followed for eight weeks postoperatively. The primary outcome was mortality within 30 days. Secondary outcomes were presence of any complication (Dindo- Grade I-V), requirement for intensive care unit (ICU) admission and for mechanical ventilation, length of hospital stay and re-admission. The results were analyzed on SPSS software version 20. Significance level was assessed by using Chi-Square test. P-values < 0.05 were considered statistically significant.

RESULTS:

A total of 1756 patients were admitted for elective and emergency surgical procedures, out of these 194 (11.04%) were found diabetic either known or newly diagnosed. Out of 194 patients 163 fulfilled the inclusion criteria for study. The known cases of diabetes mellitus were 106 (65%), while 57 (35%) patients diagnosed on admission. The age was from 22 year to 76 year, mean 46.65 +12.81 year. Majority of the patients (66.4%) age was from 41 year - 60 year followed by 61 - 80 (24.5%) years. There were 97 (59.5%) male and 66 (40.5%) females. Male to female ratio was 1.4:1. The Hb A1c level in 58 patients was > 8.5%, while 42 patients had < 6.5% on admission. Patients who underwent emergency surgery were 69 (42.3%) and elective surgery 94 (57.7%).

Superficial surgical site infection developed in 54 (33.1%) patients, among these 22 were known diabetics and 32 were newly diagnosed. Deep surgical site infections developed in 20 (12.3%) patients among these 5 cases were known diabetics and 15 were newly diagnosed. Re-admission was needed for 15 patients, among them 5 patients were known diabetics, while 10 were newly diagnosed cases. The type of surgical wound was, contaminated in 31 (19.0%), dirty in 21(12.9%) and remaining wounds were clean/ clean contaminated. Majority of the patients (n=74 - 45.4%) had hospital stay of less than 5 days, followed by 51 (31%) with 6-10 days and 13 (8%) more than 15 days. Patients who stayed for more than 15 days, among them 5 were known diabetics and 8 were newly diagnosed. Respiratory complications were observed in 21 (12.9%) followed by acute renal failure in 18 (11%) and cardiac complications in 11(6.7%) patients. Fifteen (9.2%) patients developed multiorgan failure. The mortality was 2.5%. All patients who developed systemic complications had HbA1c of more than 8.5% and underwent emergency surgery. Details are given in table I and II.

DISCUSSION:

Persistent hyperglycemia is a known preoperative modifiable risk factor. Surgical intervention on diabetic patients has higher risk of mortality and morbidity as compared to non-diabetics. Diabetic patients are more prone to undergo surgery for their surgical pathologies rather than non-diabetics.[12] Patients with higher levels of HbA1c (>8%) should be given enough time to control their hyperglycemia. These patients are prone to develop surgical site infections, prolonged hospital stay and increased mortality.[13] Surgical stress does not affect HbA1c levels and it reflects chronic hyperglycemia. Elevated levels of HbA1c may indicate poor outcome in critically ill patients and it is estimated that 1% elevation is associated with 15% to 20% risk of cardiovascular complication.[14] Known and newly diagnosed cases of diabetes mellitus are more prone to postoperative infections and other complications. Identifying probable and modifiable risk factors has clear advantages in preventing and/or minimizing

Table I: Patients Variables With Type of Surgery and Type of Wound

S. No	Variables	Wound complications	Length of Hospital Stay	Need of Re-admission	Systemic Complications
			Type of surgery		
1	Emergency	SSSI* 26 DSSI* 9	< 5 days 25 6-10 days 20 11-15 days 15 >15 days 9	Yes-9. No-60	None-24 Renal-11 Respiratory-12 Cardiac-5 Multiorgan.F-14 Death-3
	Elective	SSSI 28 DSSI 11 P= 0.170	< 5 days 49 6-10 days 31 11-15 days 10 >15 days 4 P= 0.024	Yes 6 No 88 P= 0.12	None 70 Renal 7 Respiratory 9 Cardiac 6 Multiorgan. F 1 Death 1 P= 0.000
			Type of wounds		
2	Clean/Clean contaminated	None 83 SSSI 26 DSSI 2	< 5 days 65 6-10 days 32 11-15 days 9 >15 days 5	Yes-6 No-105	None- 82 Renal- 9 Respiratory-13 Cardiac- 3 Multiorgan F-3 Death- 1
	Contaminated	None 6 SSSI 16 DSSI 6	< 5 days 9 6-10 days 10 11-15 days 10 >15 days 2	Yes-4 No-27	None- 12 Renal- 7 Respiratory-3 Cardiac- 3 Multiorgan F-4 Death- 2
	Dirty	None 0 SSSI 12 DSSS 21 P= 0.000	< 5 days 0 6-10 days 9 11-15 days 6 >15 days 6 P= 0.000	Yes-5 No-16 P= 0.02	Non- 0 Renal- 2 Respiratory-5 Cardiac- 5 Multiorgan F-8 Death- 1 P= 0.000

one of the single variables to guide surgeons before elective procedure to prevent postoperative infections.[15] In present study a strong association of elevated HbA1c and postoperative morbidity and mortality was noted which was statistically significant.

In this study patients who had Hb A1c >8.5% developed more complications than those <7.5%. These patients developed wound infection both SSSI and DSSI. Blankush JM et al study on patients who underwent elective surgery found more infection rates in those with higher level of HbA1c but was not significant.[15] Other studies conducted on orthopedics procedures observed more infection rates in higher HbA1c level group than those having lower levels. This was not found significant.[8,16] Yong et al found HbA1c not only as an independent risk factor in a large-scale study in all disciplines of surgery but also observed that each 1% rise in HbA1c level increases the risk of major postoperative complications.[10] Martin et al in a meta-analysis concluded that preoperative hyperglycemia is an independent risk factor for surgical site nfections irrespective of surgical procedure.[17]

In this study we found significantly longer hospital stay in patients with elevated HbA1c. Almogati et al did not find any significant effect on hospital stay in patients who underwent CABG.[1] This difference may be due to patient population and nature of their specific illness and surgical procedure as in cardiac patients many other variables affect the outcome.

Table II: Variables With Diabetic Status and Level of HbA1c

S. No	Variables	Wound complications	Length of Hospital Stay	Need of Re-admission	Systemic Complications
		Diabetes Status			
1	Known DM	None 79 SSSI* 22 DSSI* 5	< 5 days 61 6-10 days 29 11-15 days 11 >15 days 5	Yes 5 No 101	None 72 Renal 9 Respiratory 9 Cardiac 7 Multiorgan F 7 Death 2
	Newly Diagnosed DM	None 10 SSSI 32 DSSI 15 P= 0.000	< 5 days 13 6-10 days 22 11-15 days 14 >15 days 8 P=-0.000	Yes 10 No 47 P= 0.009	None 22 Renal 9 Respiratory 12 Cardiac 4 Multiorgan F 8 Death 2 P= 0.013
		HbA1c			
2	<6.5 (n=42)	None 40 SSSI 2 DSSI 0	< 5 days 32 6-10 days 6 11-15 days 2 >15 days 2	Yes 2. No 40	None 41 Renal 1 Respiratory 0 Cardiac 0 Multiorgan F 0 Death 0
	6.6-7.5 (n=35)	None 29 SSSI 6 DSSI 0	< 5 days 22 6-10 days 11 11-15 days 1 >15 days 1	Yes 0 No 35	None 23 Renal 5 Respiratory 5 Cardiac 1 Multiorgan F 1 Death 0
	7.6-8.5 (n=28)	None 12 SSSI 12 DSSI 4	< 5 days 10 6-10 days 9 11-15 days 5 >15 days 4	Yes 4. No 24	None 15 Renal 4 Respiratory 5 Cardiac 0 Multiorgan F 4 Death 0
	>8.5 (n=58)	None 8 SSSI 34 DSSI 16 P= 0.000	< 5 days 10 6-10 days 25 11-15days 17 >15 days 6 P= 0.000	Yes 9. No 49 P= 0.043	None 15 Renal 8 Respiratory 11 Cardiac 10 Multiorgan F 10 Death 4 P= 0.000

In a large-scale study conducted on patients above 54 years of age who underwent different surgical procedures in different disciplines of surgery by Yong et al found significantly increased duration of hospital stay with higher levels of HbA1c, which is consistent with our study.[10] In this study

we observed association of systemic complications, multiorgan failure in those patients who had higher levels of HbA1c on admission. Need for ICU admissions and mortality were also significantly associated with high HbA1c levels. Studies on cardiac surgical procedures reported that increased rate of complications and mortality were not found statistically significant.[18] Haisley et al identified diabetes mellitus as one of the significant risk factors for development of postoperative complications.[19]

CONCLUSIONS:

HbA1c is a useful modifiable independent risk factor for general surgical procedures and if found raised before elective surgery it should be addressed so to reduce the frequency of complications.

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