Original Article

Perioperative Glycemic Status Affects Postoperative Outcome in Diabetic Patients

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Abstract

Background: *Stress response during surgery may lead to hyperglycemia, osmotic diuresis and hypoinsulinemia may increase the risk of postoperative infections. The aim of the study was to find out the effects of perioperative glycemic control on postoperative outcome.* ***Material and Methods:*** *This prospective study was carried out in Ad-din Women's Medical College Hospital, Dhaka from June 2022 to December 2022 among 50 diabetic patient who were selected for various general surgery.* ***Results:*** *Among 50 study cases, only 06 (12%) developed various complications but rest of them (majority cases), 44 (88%) did not develop any complication. Among the 6 (12%) patients who developed various postoperative complications, comprised surgical site infections (49.34%), delayed wound healing (83.34%) and diabetic ketoacidosis (33.34%). These patients with postoperative complications had postoperative blood sugar level 10.0 to 14.0 mmol/l.* ***Conclusion:*** *Good long term glycemic control significantly lowers the postoperative infections.*

Keywords: Perioperative glycemic control, Postoperative blood sugar, Postoperative complications.

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Introduction

Diabetes mellitus accelerate length of hospital stay, increase in patient's expenses and also morbidity. Hospital stay of diabetic patients in surgical wards are 45% greater than diabetic patients admitted in medical wards.[1,2] Moreover, the perioperative mortality rate is up to 50% higher in diabetic patients than that of the non-diabetic patients.[3] Poor glycemic control in perioperative period leads to different metabolic complications during post-operative period.[4] Development of complications in diabetic patients after surgery mainly depend on various factors such as age, diabetic treatment regimen, level of control of glucose, pre-existing complications or illness, malnutrition, length of time with diabetes and general physical fitness.[5] The American Diabetes Association (ADA) has endorsed a target glucose range for the perioperative period of 80 to 180 mg/dl (4.4 to 10 mmol/L) though optimal perioperative glucose target has not been rigorously established. [6] Evidence of excellent glycemic target in diabetes is random glucose <170 mg/dl (9.4 mmol/L) or fasting glucose <126 mg/dl (6.9 mmol/L) and evidence of good control of diabetes is random glucose <220 mg/dl (12mmol/L) or fasting glucose <140 mg/dl(7.8mmol/L).[7] During stress like surgery and general anesthesia a neuroendocrine stress response releases counter regulatory hormones such as epinephrine, glucagon, cortisol, growth hormone and of inflammatory cytokines such as interleukin-6 and tumor necrosis factor-alpha leading to metabolic abnormalities including glucose utilization, impaired insulin secretion, increased lipolysis and protein catabolism leading to hyperglycemia and even ketosis.[8–17] Some researchers stated that the risk of various postoperative complications are high in diabetic patients such as: hyperglycemia or hypoglycemia, dehydration, hyperglycemic hyperosmolar syndrome (HHS); a situation of high glucose levels,

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dehydration, decreased consciousness, diabetic ketoacidosis (DKA), impaired wound healing, increase risk for infection and sepsis.[18,19]
Hyperglycemia leads to delayed wound healing, increased susceptibility to infection, and probable loss of administered nutrients through glycosuria.[20] During surgery stress hormones causes insulin deficiency leading to impaired glucose metabolism resulting in increased fat burn for energy. So, toxic acid by-products called ketones build up in the blood and causes diabetic ketoacidosis (DKA). People with diabetes are more likely to have poor circulation, nerve damage, weakened immune systems causing impaired wound healing, slow wound healing and increase risk for infection.[18,19] Patients with diabetes have a higher incidence of morbidity and mortality following surgery and have an increased length of stay in hospital.[21–23]

In surgical patient, there is a strong correlation between perioperative hyperglycemia and increased complications following surgery. Preoperative glycemic control also influences the risk of postoperative wound infections. So, the aim of the study was to evaluate the effects of tight glycemic control of blood over postoperative complications in diabetic patients.

Materials & Methods

This was a prospective study conducted in the Department of Surgery in Ad-din Women's Medical College Hospital, Dhaka from June 2022 to December 2022. A total number of 50 diabetic patients with age range 40 to 70 years admitted for surgery like laparoscopic cholecystectomy, hernitomy, hemorrhoidectomy and other gastrointestinal surgeries were purposively selected for the study. Following surgery patients unwilling to participate in the study and had history of heart disease, liver disease, kidney disease, any chronic diseases were excluded from the study. Planned, non-emergency surgical procedure, may be either medically required or optional surgery were considered as case of this study. We aimed to control blood glucose between 6.1-10.0 mmol/L during perioperative period. In preoperative period oral hypoglycemic agents were hold on the day before surgery and short acting insulin started. When patient was under nothing per oral (NPO) blood glucose was maintained by glucose-potassium-insulin (GKI) infusion. Perioperative blood sugar was monitored every 2 hourly to assess the hypoglycemia or hyperglycemia. Every patient were followed up for consecutive 2 weeks for emergence of postoperative complications. Data were collected by interview of patients and reviewing medical case sheet following surgery. Data regarding general medical condition of the patients, physical examination, investigation reports and their management were collected in a semi-structured questionnaire. Informed written consent was taken from the patients. Data analysis was done with the help of SPSS (Statistical package for social sciences) Version 19.0. Quantitative data were expressed as mean and standard deviation and comparison were done by *"Z"* test. Qualitative data were expressed as frequency and percentage and comparison carried by chi-square (X^2) test. Other statistical test was done whenever it is necessary. A probability value (p) of less than 0.05 was considered to indicate statistical significance.

Results

Among study cases age range was 40-70 years with diabetes mellitus where 90% were male, majority (58%) service holder. Among all participants 57% was suffering for more than 1 month. On admission, fasting blood sugar was >10 mmol/L in 96% diabetic patients (Table 1). In majority (50%) perioperative glucose was controlled by insulin and 15% controlled by

combination of all other measures (Table 2). During preoperative period 80% were maintained within <8.0 mmol/L of blood glucose level. But, in postoperative period, 12% patients became hyperglycemic (more than 10.0 mmol/L) during postoperative period in spite of tight glycemic control (Table 3). Eventually, 05 out of 06 showed delayed wound healing and 02 developed diabetic ketoacidosis who had postoperative blood glucose 12.0 to 14.0 mmol/L (Table 4).

Table I : Demographic characteristics of respondents (n = 50)

Attributes	n (%)
Age groups (years)	
40-50	10 (20.0)
51-60	25 (50.0)
60-70	15 (30.0)
Sex	
Male	45(90.0)
Female	05(10.0)
Occupation	
Service	29 (58.0)
House wife	3 (6.0)
Day Laborer	07 (14.0)
Businessman	9(18.0)
Others	02(4.0)
Religion	
Islam	47(94.0)
Hindu	03(6.0)
Monthly income	
<15000	36(72.0)
15001-30,000	10(20.0)
>30,000	04(8.0)
Duration of symptoms	
<1 month	23(46.0)
1 month -3 months	27(54.0)
Fasting blood sugar (mmol/L)	
6.1 – 8.0	0(0.0%)
8.1 – 10.0	2(4.0%)
≥ 10.0	48(96.0%)

Table II : Perioperative blood glucose management in cases (n = 50)

Attributes	n (%)
Oral hypoglycemic agents	10 (20.0)
Insulin	25 (50.0)
Combination of both	15 (30.0)
Total	50 (100)

Table III : Perioperative blood glucose status among cases (n = 50)

Variables (mmol/L)	Preoperative period	Post-operative period
	n (%)	
< 8.0	40(80.0)	20 (40.0)
8.1-10.0	10(10.0)	24 (48.0)
10.1-12.0	0	1(2.0)
12.1-14.0	0	5 (10.0)

Table IV : Postoperative outcome among hyperglycemic cases during postoperative period (n = 6)

Postoperative glucose level (mmol/l)	n (%)				*p*
	Surgical site infections (SSI)	Delayed wound healing	Diabetic ketoacidosis	No complication	
10.00 -12.00	1(16.0)	0	0	0	< 0.05
12.00 – 14.00	2*(33.34)	5*(83.34)	2*(33.34)	0	
*Multiple response					

Discussion

Blood glucose level is the most important risk factor for postoperative morbidity and mortality in case of diabetic patients. Post-surgical stress response may initiate hyperglycemia, osmotic diuresis and hypoinsulinemia leading to postoperative infections.

In present study, among 50 diabetic patients 6 developed various complications (p<.05) who had blood sugar level more than 10 mmol/L during postoperative period regardless of all control measures. Postoperative complications were

surgical site infection (n=3), delayed wound healing (n=5), diabetic ketoacidosis (n=2), surgical site infections (n=1). Majority were free from any complications as they were adjusted to blood glucose level between 8.0 to 10.0 mmol/L.

Vogel et al. studied postoperative complications of 870,778 elective vascular surgical procedures where found 3.70% overall postoperative infection rate.[24] Tang et al. found 7.2% major medical complications and 1.7% wound complications in 236 eligible cases.[25] Same types of study was found by Van den Berghe et al. where tight glycemic control to maintain blood glucose level in the lower range of 4.4 - 6.1 mmol/L improved mortality and morbidity.[26] But in another study perioperative glycemic control in the range of 8.3 – 11.1 mmol/L significantly reduced postoperative infections. Good long term glucose control is strongly associated with significantly fewer postoperative infections.[27] Though recent meta-analysis showed that tight glycemic control increase the risk of hypoglycemia.[28]

Kitara et al. found post operative complications among 76 laparotomy patients like respiratory tract infection (28.2%), wound hemorrhage (18.2%), anemia (15.5%), hypotension (14.1%), UTI (2.2%), anastomotic leak (1.4%), wound sepsis (9.9%), wound dehiscence (4.2%) and thromboembolism (1.4%).[29] On the contrary, Guckelberger et al. could not identify diabetes as an independent variable having an impact on mortality and those overall complications were equally frequent between diabetic and non-diabetic patients.[30]

Although the mechanism by which blood glucose predisposes to postoperative complications is not well understood though it proposed as a causative factor for higher infection rate in diabetic persons. So, risk factors in surgery that might contributes to morbidity and mortality are surgical site infection, hyperglycemic hyperosmolar syndrome, diabetic ketoacidosis, and surgical site infections.

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Conclusion

Proper glycemic control plays a pivotal role in preventing postoperative infections. Diabetic patients are at risk of developing various types of post-surgical complications despite of proper glycemic control. So a lower normal range could be maintained to avoid postoperative complications. And this study could help surgeons to be concern about effects of blood sugar level on postoperative infection.

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