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A Prospecive Study on Relationship Between Pre-Operative Hyperglycemia and Post-Operative Complications in Diabetic Patients Undergoing Elective Surgeries

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Pre-surgical hyperglycemia has been linked to postoperative complications after surgical procedures. Recent research has shown that hyperglycemia plays a key role in creating postoperative complications. Therefore, HbA1C was highly targeted to determine whether it was an independent factor affecting postoperative complications and associated diseases. However, the target glucose level remains unclear to prevent problems due to abnormal glucose levels. To study pre-operative hyperglycemia with the risk of development of postoperative complications in diabetic patients undergoing elective surgeries by conducting a prospective observational study. 80 patients undergoing a variety of general elective surgical procedures were taken into the study and followed for about 30 days post-surgery for any possible complications. Their Random Blood Sugar (RBS) values were taken preoperatively and postoperatively every 8 hours. And the HbA1C values of the patients were noted before the surgery. The study's primary endpoints were the incidence of surgical site infections (SSIs), Delayed Wound Healing (DWH), Pain, and Septic shock. Out of 80 patients, 19 developed hyperglycemia (prevalence = 23.75%). In normoglycemic patients, the infection rate was 15% (6/40) compared to 35% (14/40) in preoperative hyperglycaemic groups. Post-surgical infections are usually common and are expensive. It is a burden to the people who have poor economic status. Chronic abnormal levels of blood glucose in the body impair the healing process of the wound (here, surgical incision) thereby leading to complications. The occurrence of Postoperative complications in diabetic patients is multifactorial. Our study demonstrated an association between the pre-operative glucose control indicated by HbA1C and post-operative complications. However, the size of the sample is the major limitation of this study. The impact of long-term glycemic control and its variation on any postoperative complications could be considered by conducting more efficient studies in the future taking a larger sample size.

Keywords: Glycated Haemoglobin (HbA1c); Preoperative Hyperglycemia; Postoperative Complications; Random Blood Sugar.

Pre-existing diabetes mellitus, along with continuous hyperglycemia in pre-operative conditions has been shown to affect post-operative outcomes[1] in patients undergoing various types of general surgical procedures. Pre-operative hyperglycemia (HbA_1C e" 6.5%)[1] is suggested to be associated with postoperative infectious complications like surgical site infections (SSI's), Delayed wound healing(DWH), Deep wound infections, and Surgical space abscesses[2], with pain at the surgical site and septic shock accounting for the highest percentage of these complications.

Any infection or impaired wound healing in the immediate post-operative period leads to poor surgical outcomes and increased healthcare costs (due to increased length of hospital stay (LOHS)). Evidence from previous studies suggests that HbA_1C levels (e" 6.5%)[3] in diabetic patients play a significant role in developing post-operative risks in diabetic patients. Hence a good pre-operative control of glycemic levels results in better post-operative outcomes.[2,3]

Long-term glucose deregulation is considered a risk factor for post-operative complications.[4] Many studies have been carried out to assess whether Glycated hemoglobin alone is associated with increased complications after surgeries. Studies suggested that the presence of at least one co-morbidity along with higher Glycated hemoglobin (HbA_1C) levels in the pre-operative state contributed to increased postoperative complications.[4,5,6] Also, pre-operative hyperglycemia is considered to be a major risk factor for an increased rate of morbidity and mortality in critically ill patients that may be controlled with INTENSIVE INSULIN THERAPY (IIT).[7] However, HbA_1C may also be a useful tool in predicting increased post-operative infectious complications. Hence pre-operative monitoring of blood glucose levels[6] and control of pre-operative hyperglycemia is an essential factor in reducing post-operative infectious complications and morbidity in diabetic patients.[3,6,8]

The present study is designed to assess the relationship between pre-operative hyperglycemia and the incidence of postoperative complications. We hypothesize that diabetic patients (with HbA_{1C} levels e"6.5%) are at increased risk of complications compared to non-diabetic patients (with HbA_{1C} <5.5%).

MATERIALS AND METHODS

This prospective observational study was carried out in the Department of General Surgery, Owaisi Hospital and Research Centre, Hyderabad, India.

A total of 80 patients who underwent elective surgeries in Owaisi Hospital and Research Centre, from August 2019 to January 2020 were identified using patients' medical records (lab investigation reports, logbooks, case sheets, etc.). These records provided demographic and clinical information about patients such as age, gender, relevant clinical data, HbA_{1C} values, type of surgery, length and notes of operation, and information on post-operative complications. Informed consent was received from all the study participants.

All [Diabetic and Non-Diabetic] patients, above 18 years of age, undergoing elective surgeries like Appendectomy, Cholecystectomy, Debridement/Fasciotomy, Hernioplasty, Thyroidectomy, Skin grafting, etc., were enrolled in this study.

Patients not willing to participate or have coronary artery disease (CAD) and Epilepsy, and those who underwent Laparoscopy procedures and emergency surgeries were excluded from the study.

Based on the Preoperative HbA_{1C} levels, the patients were classified into 3 groups. Group 1, which is a control group that includes non-diabetic patients, Group 2, included diabetic patients with normal HbA_{1C} levels (<6.5), and Group 3, included diabetic patients with elevated HbA_{1C} levels (>6.5). In postoperative stages, after every 8 hours, the RBS was checked & Human Actrapid Insulin was administered according to the RBS levels. The patients were observed for any postoperative complications during the hospital stay, and the progress of wound healing was noted. The presence of any postoperative complications like Surgical Site Infections (SSI's), Delayed wound healing, pain, and septic shock were examined. SSI's were classified according to CDC (Center for Disease Control and Prevention). Pharmacological management was also studied to check the concordance of administered antibiotics with the standard guidelines (Infectious Disease Society of America- IDSA, National Institute for Health and Care Excellence- NICE, National Antibiotic Guidelines 2018, World Health Organization-WHO). All discharged patients were followed up till one month after surgery, to observe any complications.

Statistical Analysis

All data management and analysis were done by using SPSS software version 20. The descriptive statistics were used to describe the study findings. The association between Pre-

operative HbA_{1C} and Postoperative complications was tested, and the *p* value was calculated using the Chi-square test.

RESULTS

A total of 93 cases were collected during the study period. Of these, 13 cases were excluded from the study owing to the lack of proper laboratory findings, insufficient follow-up and, already existing infections. In our study, Males were recorded more compared to female patients i.e., 51 and 29 respectively. However, gender distribution did not play any significant role in the postoperative complications. The average age (in years) of both the groups showed no significant difference and it was 52.13 ± 12.21 and 41.33 ± 15.85 respectively. Table 1 shows that cases included in the study have undergone the following procedures – Cellulitis (19.5%), Hernia (22.5%), Diabetic foot (9.5%), Appendicitis (13.5%), Cholecystitis (9%), Pancreatitis (8%), Liver abscess (8%), Hemorrhoids (5%) and others. The Hernia was seen in the majority of the cases followed by cellulitis. Out of 40 cases collected of Diabetic patients, increased Random blood sugar levels were observed (i.e., >140mg/dL) in 28 cases. A chi-square test was performed to define the association of pre-operative hyperglycemia and postoperative complications. A statistically significant difference was found across groups in the data obtained (Table 2). In Figure 1, It is observed that the postoperative complications were noted more in Hyperglycemic patients having HbA_{1C} levels >6.5% compared to normoglycemic patients. Outcome measures also included the prevalence of SSI's, delayed wound healing and wound dehiscence, and wound cultures to detect the source of infection in the included cases (Figure 2). In addition, the Antibiotic concordance attributed to the standard guidelines by NICE, IDSA, and national antibiotic guidelines 2019, WHO were also considered for all the cases. Based on the selection of Antibiotics, we found that 77.5% of diabetics and 62.5% of non-diabetics showed concordance with the standard guidelines (Figure 3).

DISCUSSION

Postoperative infections are common and often expensive. As it increases the need for costs in the health sector it places a burden on people in

Table 1. Distribution based on diagnosis

S. No	Diagnosis	Group I		Group II	
		N	%	N	%
1	Cellulitis	10	25	0	0
2	Hernia	8	20	14	35
3	Diabetic foot	6	15	0	0
4	Appendicitis	0	0	6	15
5	Cholecystitis	3	8	0	8
6	Pancreatitis	2	5	2	5
7	Liver Abscess	2	5	1	3
8	Hemorrhoids	0	0	4	10
9	Others	9	22	13	22

Table 2. Group-wise distribution of patients with mean HbA_1C Values & Complication

S No.	Group	HbA_1C Classification	HbA_1C Mean ± SD	Total No. of Cases	Complication Occurrence % (No. of Cases)	*p*-value
1	Non- Diabetic	(<6.0)	5.35 ± 0.22	40	15% (6)	0.0023*
2	Diabetic	1A (<6.5)	6.16 ± 0.16	6	33% (2)	
		1B (>6.5)	9.32 ± 2.64	34	35% (12)	

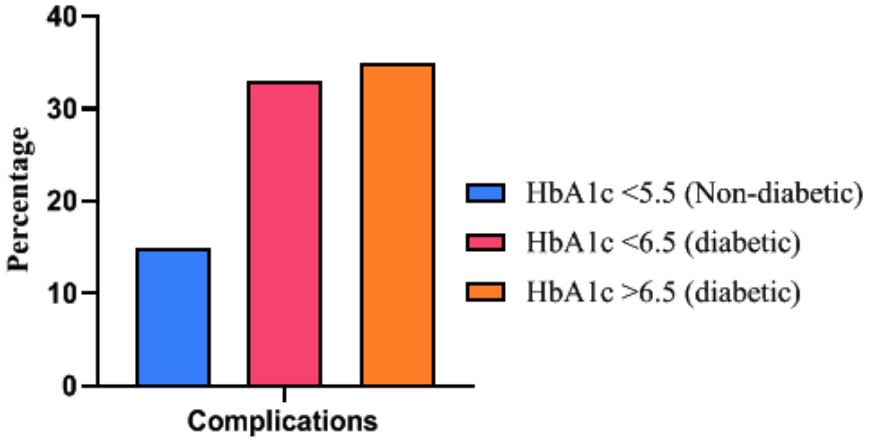

Fig. 1. Complication Occurrence

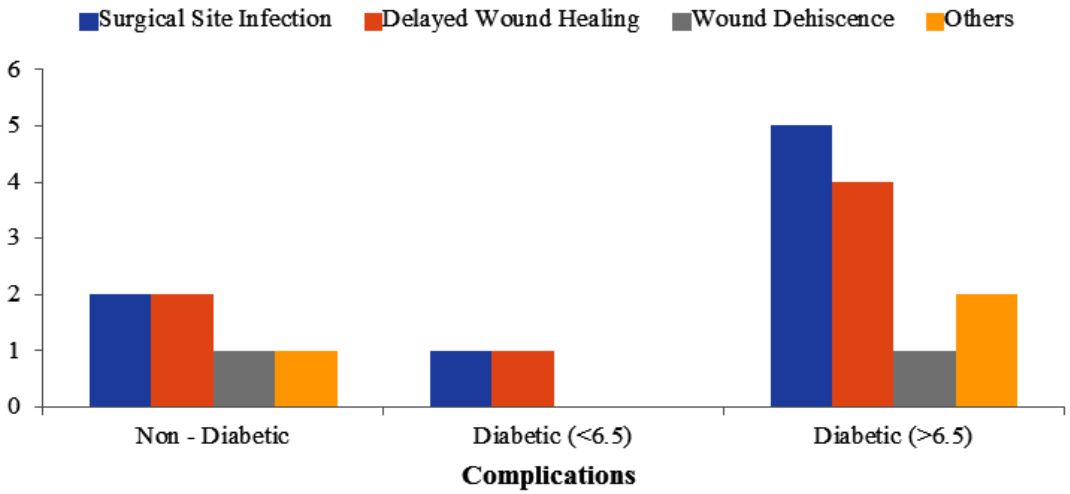

Fig. 2. Postoperative complication types

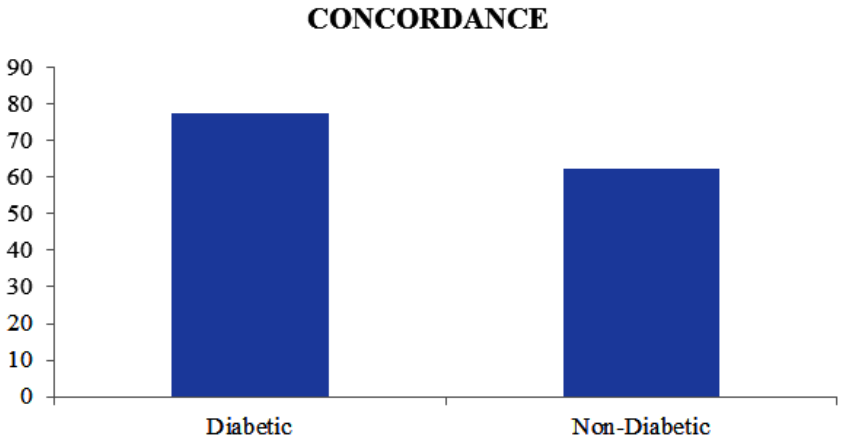

Fig. 3. Antibiotic Concordance

a low-income economy. Increased glucose levels in the body interfere with the wound-healing process (surgical cutting).[9]

As a result of the potential relationship between preoperative hyperglycemia and its risk of postoperative complications, a prospective study was conducted to confirm the organization and its management.

Of the 80 registered cases, 40 cases (50%) were diagnosed with preoperative hyperglycemia. The prevalence of hyperglycemia varies depending on a variety of factors. The different types of studies, the different processes involved, and the different levels of glycemic control are often important. Among Indians and Asians' these glycemic controls are considered insignificant and therefore, the prevalence of hyperglycemia may be high in our studies.[10,11,12,13]

In our study, approximately 35 percent of cases experienced serious post-operative complications found to be patients with preoperative hyperglycemia with high HbA_{1C} levels. The dangers of these problems can be many factors, which may be synergistic, and affect the number of patients differently. HbA_{1C}, although not a stand-alone factor, still is an important and useful factor in predicting the risk of infection after surgery in diabetic patients.

The risk of developing infection among hyperglycemic patients was seen by 35% compared to 15% among normoglycemic patients. However, many studies have confirmed that postoperative complications are often the result of preoperative hyperglycemia.[2]

In this study, we tried to link preoperative hyperglycemia with postoperative diseases and complications. Although evidence supports the findings,[14,15] our study shows statistically significant differences across classified groups; because of the data collected and analyzed in the study's limited sample size. Therefore, a large amount of data is needed to support this link between preoperative hyperglycemia and postoperative complications.

In addition, we have also examined the degree to which the clinicians in the teaching hospital attributed to the standard guidelines in prescribing the antimicrobials/antibiotics in patients undergoing these surgical procedures and the management of complications if found any, post-operatively.[16] Based on the selection of antibiotics, we found that the management fully complied with the standard guidelines in 77.5% and 62.5% in both diabetic and non-diabetic groups respectively

However, apart from the above factors, problems can also be seen in patients who do not adhere to their medication who live in poor hygiene conditions, and who neglect their diabetic diet as needed. Therefore, in addition to finding an association, we have also tried to educate patients about their diagnosis, surgical procedures, adherence to prescribed medications, proper diet, and hygiene that can help reduce the risk of concomitant complications.[17]

CONCLUSION

The occurrence of Postoperative complications in diabetic patients is multifactorial. Our study demonstrated an association between the pre-operative glucose control indicated by HbA_{1C} and post-operative complications. However, the size of the sample is the major limitation of this study. The impact of long-term glycemic control and its variation on any postoperative complications could be considered by conducting more efficient studies in the future by taking a larger sample size.

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Conflict of Interest

The author(s) do not have any conflict of interest**.**

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

The study received Ethical Clearance from the Institutional Review Board of Deccan College of Medical Sciences [IRB No: 2019/29/005].

Informed consent statement

This study did not involve human participants, and therefore, informed consent was not required.

Clinical trial registration

This research does not involve any clinical trials.

Authors' Contribution

MF (Mohammed Fareedullah): Conceptualization, Methodology, Design, Review, Supervision; BK (Bebe Khadeeja), SF (Sadia Fatima), ST (Sheema Taher), SMHR (Syed Mohd Hasan Razvi): Data Collection, Analysis, Writing & Editing; SNF (Syed Nusrath Farees), MAH (Mohd Abdul Hadi): Visualization, Resources, Validation

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