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ORIGINAL ARTICLE

Comparison of the frequency of post-operative wound infection and mean length of ICU stay after tight versus standard glycemic control among diabetic patients undergoing CABG.

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ABSTRACT… Objective: To compare post-operative wound infection rates and average ICU stay length in diabetic patients undergoing coronary artery bypass surgery at Azra Naheed Medical College, Lahore, based on strict glycemic control versus standard glycemic control. **Study Design:** Randomized Controlled Trial. **Setting:** Azra Naheed Medical College, Lahore. **Period:** January 2023 to June 2023. **Methods:** Total 260 eligible diabetic patients scheduled for surgery provided informed consent following ethical committee approval. A lottery-based randomization process allocated patients to Group A (tight glycemic control, blood sugar levels 120-160 mg/dL) or Group B (standard glycemic control, blood sugar levels 161-200 mg/dL). Treatment was as per standard protocols, and blood sugar levels were monitored accordingly. Proforma entries documented ICU stay and wound infections during hospitalization, ensuring data confidentiality. **Results:** The study involved 260 cases, with 130 in each group. In Group-B, the mean age was 51.56+6.07 years, and in Group-A, it was 52.09+5.86 years. Males constituted 53.85% (n=70) in Group-B and 53.08% (n=69) in Group-A, while females were 46.15% (n=60) in Group-A and 46.92% (n=61). Wound infection development differed, with 29.23% (n=38) in Group-A and 59.23% (n=77) in Group-B. The remaining 70.77% (n=92) in Group-A remained infection-free. Regarding mean hospital stays, Group-A stayed for 3.92+0.95 days, while Group-B spent 5.73+0.76 days (p = 0.0001). **Conclusion:** Strict glycemic control significantly reduces postoperative infections and ICU stay duration in diabetic patients undergoing coronary artery bypass surgery compared to standard glycemic control.

Key words: Coronary Artery Bypass Surgery, CABG, Perioperative Glycemic Control, Diabetes Mellitus, Post-operative Hospital Stay, Standard Glycemic Control, Tight Glycemic Control, Wound Infection.

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INTRODUCTION

Diabetes mellitus (DM), a prevalent chronic condition characterized by compromised immune function, impacts an estimated 350 million individuals worldwide.[1] Pakistan has one of the ten greatest prevalence of diabetes patients globally, which is correlated with an elevated risk of coronary artery events.[2,3] A well-documented phenomenon in perioperative and postoperative cardiac surgery, hyperglycemia is associated with an unfavorable prognosis. It is associated with increased mortality, protracted hospital stays, and contamination of surgical wounds.[4] Consequently, in order to ensure favorable outcomes for patients undergoing coronary artery bypass surgery (CABG), glycemic control becomes crucial.[5]

Diverse glycemic control strategies have been suggested in an effort to improve the prognosis of these patients. These include strict glycemic control and standard glycemic control using a sliding scale model; however, the available literature indicates that these strategies have variable effects on ICU duration of stay and post-operative wound infection.[6] The two strategies did not correlate in a statistically significant way with the duration of ICU stay or postoperative wound infection, according to a study by Konstantinos et al.[7]

Pakistan has a rising diabetes rate. The International Diabetes Federation estimates 33,000,000 cases of diabetes in Pakistan in 2022, 26.7% of adults. Pakistan's type 2 diabetes prevalence is 11.77%, greater in cities than rural areas.

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Diabetes is a major public health issue and increases the risk of coronary heart disease. Hyperglycemia, which is common in diabetic and non-diabetic cardiac surgery patients, is linked to higher mortality, longer hospital stays, and surgical wound infections.[8,9] Thus, glucose management is essential for CABG patients' success.

Hyperglycemia affects postoperative healing and increases surgical infection risk, emphasizing the need to manage it. Diabetes is a major public health issue in Pakistan, hence effective prevention and management are needed.[10]

The purpose of this research is to compare the incidence of postoperative wound infection and ICU duration of stay following strict glycemic control versus standard glycemic control. Due to the lack of local literature and the inconsistent results found in the existing literature, this study will produce additional evidence based on our population. This information may offer clinician's insights into the most effective glycemic control technique to implement in diabetic patients undergoing coronary artery bypass grafting (CABG), with the ultimate goal of reducing morbidity and mortality rates.

METHODS

By comparing the incidence of post-operative wound infection and the average length of intensive care unit (ICU) stay among diabetic patients undergoing coronary artery bypass surgery at Azra Naheed Medical College, Lahore for ischemic heart disease under strict glycemic control versus standard glycemic control; this study aims to determine which modality is more effective.

The research was a randomized controlled trial; data collection was done for six months (from January'2023 to June'2023) subsequent to the approval of the synopsis by the CPSP and Ethical Review Board (ANMC/ME/01/23/060, Dated: 04-January-2023 in the name of Dr M. Ammar) at the Azra Naheed Medical College, Lahore.

Approximately 260 diabetic patients who met the inclusion criteria and were scheduled to undergo coronary artery bypass surgery at Azra Naheed Medical College, Lahore were approached and provided informed consent subsequent to the study protocol receiving approval from the hospital's ethical committee. The proforma contained notation pertaining to the demographic data of the individuals. The patients were allocated into two categories through a lottery-based randomization process. The patients in Group A (tight glycemic control) had blood sugar levels maintained between 120 and 160 mg/dL, while those in Group B (standard glycemic control) had blood sugar levels maintained between 161 and 200 mg/dL. Annexes detailing treatment protocols are included.

The selection criteria for the patients for this study was: 'Individuals of age 30 to 60 years, of either gender who have been diagnosed with diabetes for a minimum of five years and are undertaking coronary bypass surgery for ischemic heart disease.

Exclusion criteria for this study were: 'Patients who express a voluntary refusal to partake in the research; patients with renal dysfunction (estimated GFR<60ml/min/1.73m2), chronic obstructive pulmonary disease (FEV1/FVC ratio<0.7), or who were currently receiving immunosuppressive therapy, as confirmed on history and from their medical records; Patients who exhibit severe ventricular arrhythmias (ventricular tachycardia and/or fibrillation) within the first twenty-four hours of their intensive care unit (ICU) admission undergo cardioversion; Individuals who had undergone prior cardiac surgery; intraoperative and/or within the initial 48 hours after the procedure; mediastinal re-exploration for hemorrhage; support for hemodynamics with an intra-aortic balloon pump (IABP).

The sample size was determined, using an 80% power of test, a 5% level of significance, and an expected mean duration of ICU stay of 3.2+4.7 days for patients with strict glycemic control as opposed to 2+1.2 days for those with standard glycemic control.[5]

Consecutive non-probability sampling technique was used for selection of the patients.

The blood sugar level of all the patients was monitored and recorded in accordance with the

methodology. Patients were monitored, and proforma entries were made for the duration of ICU stay and the occurrence of wound infections during hospitalization. Data confidentiality was guaranteed.

The information was entered and analyzed utilizing version 23.0 of SPSS. Age and length of hospitalization were numerical variables analyzed in the form of means and standard deviation. The data for qualitative variables, such as the occurrence of wound infections and gender, was expressed as frequencies and percentages. Age, gender, and duration of DM were utilized to stratify the data in order to account for the effect modifiers. For statistical significance analysis, the independent t-test and post-stratification chi-square test were utilized according to the type of the variable; taking p-value less than 0.05 as statistically significant.

RESULTS

In order to compare the frequency of post-operative wound infection and mean length of intensive care unit (ICU) stay among diabetic patients undergoing coronary artery bypass surgery due to ischemic heart disease at Azra Naheed Medical College, Lahore, a total of 260 cases (130 in each group) that met the inclusion/exclusion criteria were enrolled.

The age distribution of the participants indicates that 15.38% (n=20) of Group-B and 87.69% (n=114) of Group-A were between the ages of 30 and 45, while 84.62% (n=110) were between the ages of 46 and 60. The mean + standard deviation for Group-A was 52.09+5.86 years and for Group-B it was 51.56+6.07 years.

Males comprised 53.85% (n=70) of Group-A participants and 53.08% (n=69) of Group-B participants, while females comprised 46.15% (n=60) of Group-A and 46.92% (n=61) of Group-B participants.

A comparison of wound infection development in both groups reveals that 29.23% (n=38) of participants in Group-A and 59.23% (n=77) of participants in Group-B developed an infection, while the remaining 70.77% (n=92) of participants in Group-A and 40.77% (n=53) in Group-B did not have any infection (p = 0.000). A comparison of the mean hospital stays in both groups reveals that Group-A stayed for 3.92+0.95 days, while Group-B spent 5.73+0.76 days; the p value was 0.0001. (as shown in the tables below)

Age, gender, and duration of DM were utilized to stratify the data in order to account for the effect modifier. For statistical significance analysis, the independent t-test and post-stratification chi-square test were utilized. A p-value less than 0.05 was regarded as statistically significant.

TABLE-I

Comparison of development of wound infection in both groups (N=260)

Wound Infection	Group-A (n=130)		Group-B (n=130)	
	No.	%	No.	%
Yes	38	29.23	77	59.23
No	92	70.77	53	40.77
Total	130	100	130	100

P value=0.0001

TABLE-II

Comparison of duration of hospital stay in both groups (N=260)

Duration of Hospital Stay (Days)	Group-A (n=130)		Group-B (n=130)	
	Mean	SD	Mean	SD
	3.92	0.95	5.73	0.76

P value=0.0001

Statistically significant differences were observed in the duration of hospital stays when age, gender, and tenure of diabetes were accounted for in the stratification process ($p < 0.0001$). Although the results of the stratification of wound infection data by age were not statistically significant for young adults, they were ($p = 0.001$) for the elderly. Furthermore, a statistically significant increase in the incidence of wound infections was noted among female patients, specifically in Group B ($p < 0.0001$). Additionally, the length of time that diabetes was present was found to be a substantial determinant in the occurrence of wound infections (p-value = 0.0001).

DISCUSSION

The objective of this study was to compare the duration of ICU stay and incidence of postoperative

wound infection between patients who received strict glycemic control and those who received standard glycemic control. In light of the scarcity of local literature and the incongruous findings observed in the extant research, this investigation has the potential to generate supplementary evidence concerning our demographic. With the ultimate aim of reducing morbidity and mortality rates, this information may provide clinicians with insights regarding the most efficacious glycemic control technique to employ in diabetic patients undergoing coronary artery bypass grafting (CABG).

Of 260 cases analyzed in total (130 cases in each category) in accordance with our research, 12.31% (n=16) in Group-A and 15.38% (n=20) in Group-B belonged to the 30-45 age group, whereas 87.69% (n=114) in Group-A and 84.62% (n=110) were between the ages of 46-60. The calculated mean and standard deviation for Group-A and Group-B were, respectively, 51.56+6.07 years and 52.09+5.86 years. Group-A consisted of 46.15% (n=60) males, while Group-B had 46.92% (n=61) males. Group-A exhibited a mean hospital stay of 3.92+0.95 days, whereas Group-B maintained a mean stay of 5.73+0.76 days (p value = 0.0001; significance level: 0.0001).

A previous study conducted by Subhani et al. found that patients undergoing post-operative wound infection were statistically significantly less likely to develop such infections when they were on strict glycemic control (33.87% vs. 61.29%).[11] Conversely, Chan demonstrated that patients undergoing strict glycemic control had a substantially shorter length of stay in the intensive care unit (4.1 vs 6.9 days) and a significantly lower incidence of postoperative wound infection (19.1% vs 35.2%) than those undergoing standard glycemic control.[12] Significant disparities were observed in the analysis of wound infection progression between the two groups in our research. A total of 38 participants, or 29.23%, contracted wound infections under strict control conditions; the remaining 70.77% (n=92) maintained infection-free status. In contrast, patients on conventional glycemic control had a greater incidence of wound infections, affecting 59.23% (n=77) of the 130 participants. Notably, a mere 40.77% (n=53) of the participants in Group-B remained unaffected by infections. A significant correlation (p = 0.0001) was observed between the type of glycemic control and wound infection, as determined by the statistical analysis.

In their study, Haga et al. compared the duration of intensive care unit (ICU) stays of patients with strict glycemic control (3.2+4.7 days) to those with standard glycemic control (2.2+1.2 days).[13] Our findings are in-consistent with those of Konstantinos et al., who did not observe a statistically significant correlation between the two strategies and the duration of postoperative wound infection or ICU stay.[14]

Ehab A. Wahby et al[15] conducted an additional investigation with the purpose of comparing the outcomes of diabetic patients undergoing coronary artery bypass graft (CABG) surgery when subjected to moderate versus strict perioperative glycemic control. Their findings indicated that strict glycemic control resulted in a more favorable outcome for diabetic CABG patients. Consistently advising diabetic patients undergoing CABG surgery to maintain perioperative blood glucose levels within the range of 110 to 149 mg/dL is both safe and worthwhile.

Zerre et al. identified an independent risk factor for sternal incision infection as an elevated blood glucose level within 48 hours of the procedure in their retrospective study[10] and a separate investigation conducted by Elassi et al. revealed that diabetic patients who underwent CABG surgery fared well, with the exception of sternal incision infection.[11] The initial examination of the correlation between strict glycemic control and reduced surgical wound infection occurred in 1991, when the American College of Cardiology and American Heart Association identified a heightened prevalence of such infections among patients with diabetes.[12]

It has been postulated that hyperglycemia may impact leukocyte function through mechanisms such as diminished bactericidal capability, phagocytosis, chemotaxis, and adherence to microbes. Furthermore, there is an inverse correlation between the degree of hyperglycemia and leukocyte function.[16]

In a meta-analysis examining the impact of strict glycemic control on patient morbidity and mortality, Haja et al. discovered that patients undergoing strict glycemic control required significantly less time for ventilation than the control group. However, substantial heterogeneity existed in the data, which the Lazar study significantly emphasized.[8]

In summary, the results of our study in accordance with most of the above studies justify the hypothesis that "there is a difference in frequency of postoperative wound infection and mean length of ICU stay with tight glycemic control as compared to standard glycemic control among diabetic patients undergoing coronary artery bypass surgery".

CONCLUSION

The incidence of postoperative wound infections and the average duration of intensive care unit (ICU) stays are considerably reduced in diabetic patients undergoing coronary artery bypass surgery when strict glycemic control is implemented, as opposed to standard glycemic control.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Mohsin Shabbir:** Data collection, Analysis.
2	**Taimoor Khan:** Manuscript writing.
3	**Muhammad Ammar:** Data entry.
4	**Zafar Tufail:** Review of manuscript.
5	**Awais Hussian Kazim:** Discussion writing.
6	**Shahryar:** Critical revision.