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RESEARCH ARTICLE

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COMPARISON OF STERNAL WOUND INFECTION FREQUENCY IN DIABETIC PATIENTS WITH NORMAL AND RAISED GLYCOSYLATED HEMOGLOBIN LEVEL AFTER CORONARY ARTERY BYPASS GRAFTING

Faiq Ahmed Khan[1], Yasir Naseem[2]*

[1]Assistant Professor, Lady Reading Hospital, Peshawar, Pakistan

[2] Assistant Professor, Lady Reading Hospital, Peshawar, Pakistan

Corresponding author: Yasir Naseem ***dr.yasirnaseem@yahoo.com***

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ABSTRACT

Background: Sternal wound infection (SWI) is one of the most serious postoperative complications after coronary artery bypass grafting (CABG), particularly in diabetic patients. Poor glycemic control may impair immunity, delay tissue repair, and increase the risk of postoperative wound infection. Glycosylated hemoglobin (HbA1c) is a reliable marker of long-term glycemic control and may help identify high-risk patients before cardiac surgery. Objective: To compare the frequency of sternal wound infection in diabetic patients with normal and raised HbA1c levels after CABG. Methods: This descriptive case series was conducted in the Department of Adult Cardiac Surgery, AFIC/NIHD, Rawalpindi, from November 2019 to May 2022. A total of 130 known diabetic patients undergoing elective CABG were included through non-probability consecutive sampling. Patients were divided into two groups: 65 patients with normal HbA1c and 65 patients with raised HbA1c. Patients were followed for 21 postoperative days for signs of sternal wound infection. Data were analyzed using SPSS version 23. The chi-square test was applied, and $p <= 0.05$ was considered statistically significant. Results: The overall frequency of postoperative SWI was 10/130 (7.69%). Infection occurred in 2/65 patients (3.08%) in the normal HbA1c group and 8/65 patients (12.31%) in the raised HbA1c group. The difference was statistically significant ($p = 0.048$). The highest infection frequency was observed in patients with HbA1c >= 8%, where 8/25 patients (32.00%) developed infection. Conclusion: Raised HbA1c is significantly associated with a higher frequency of sternal wound infection after CABG in diabetic patients. Preoperative HbA1c assessment, better glycemic optimization, and careful postoperative wound surveillance should be emphasized in diabetic patients undergoing elective CABG.

Keywords: HbA1c, diabetes mellitus, coronary artery bypass grafting, sternal wound infection, postoperative infection, cardiac surgery.

INTRODUCTION

Diabetes mellitus is a major global health problem and one of the strongest risk factors for coronary artery disease [1]. Patients with diabetes frequently develop accelerated atherosclerosis, endothelial dysfunction, chronic inflammation, and diffuse coronary vessel involvement [2]. Because of this advanced coronary disease pattern, many diabetic patients require coronary artery bypass grafting (CABG), especially when the disease is extensive, complex, or unsuitable for percutaneous coronary intervention [3]. Evidence from major revascularization trials has shown that CABG remains an important treatment option in diabetic patients with multivessel coronary artery disease [4].

Although CABG improves myocardial blood supply and long-term cardiac outcomes, it is associated with important postoperative complications. Diabetic patients are particularly vulnerable because hyperglycemia impairs immune response, delays collagen synthesis, worsens microvascular circulation, and reduces wound healing capacity [5,6]. HbA1c is widely used

as a marker of average blood glucose control over the previous two to three months and is useful for identifying patients with chronic hyperglycemia before surgery [7,8].

Sternal wound infection (SWI) is a serious complication after median sternotomy. It may range from superficial wound infection to deep sternal wound infection and mediastinitis [9]. This complication increases hospital stay, treatment cost, reoperation risk, morbidity, and mortality [10]. Several risk factors have been associated with SWI, including diabetes mellitus, obesity, smoking, prolonged operative time, internal mammary artery harvesting, and poor perioperative glucose control [11,12].

Previous studies have reported that elevated preoperative HbA1c increases the risk of SWI after isolated coronary surgery [13,14]. However, local data from Pakistan remain limited, especially in cardiac surgery patients undergoing CABG. Therefore, this study was conducted to determine and compare the frequency of SWI in diabetic patients with normal and raised HbA1c levels after CABG [15].

METHODOLOGY

This descriptive case series was conducted in the Department of Adult Cardiac Surgery, AFIC/NIHD, Rawalpindi, from November 2019 to May 2022, after approval from the hospital ethical and research committee. A total of 130 known diabetic patients undergoing elective CABG for coronary artery disease were included through non-probability consecutive sampling. Patients were allocated into two groups on the basis of preoperative HbA1c: 65 patients with normal HbA1c and 65 patients with raised HbA1c.

Inclusion criteria: Patients aged 18-80 years, taking oral antidiabetic drugs or insulin, and undergoing on-pump or off-pump CABG were included.

Exclusion criteria: Patients with chronic renal dysfunction, severe chronic obstructive pulmonary disease, chronic bone disease, chest wall or sternal deformity, redo CABG, redo valve surgery, or postoperative re-exploration were excluded.

After written informed consent, demographic and clinical data, including age, gender, body mass index (BMI), duration of diabetes, diabetic treatment, and preoperative HbA1c level, were recorded on a predesigned proforma. Patients were followed for 21 postoperative days to assess SWI, which was diagnosed on the basis of wound pain, erythema, fever >= 38°C, purulent discharge, and culture evidence where available.

Data were analyzed using SPSS version 23. Mean ± standard deviation was calculated for numerical variables, while frequencies and percentages were calculated for categorical variables. The chi-square test was applied after stratification, and a p-value <= 0.05 was considered statistically significant.

RESULTS

A total of 130 diabetic patients undergoing CABG were included. There were 65 patients in the normal HbA1c group and 65 patients in the raised HbA1c group.

Age: The mean age was similar in both groups: 62.41 ± 1.09 years in the normal HbA1c group and 61.96 ± 2.64 years in the raised HbA1c group. Most patients belonged to the 61-70-year age group. The difference in age distribution was not statistically significant ($p = 0.753$).

Gender: Male patients were more frequent in both groups: 34 males (52.31%) in the normal HbA1c group and 39 males (60.00%) in the raised HbA1c group. Gender distribution was not significantly different ($p = 0.873$).

BMI: The mean BMI was higher in the raised HbA1c group (32.61 ± 1.98 kg/m²) compared with the normal HbA1c group (28.98 ± 2.46 kg/m²). Obesity (BMI >= 30 kg/m²) was more common in the raised HbA1c group than in the normal HbA1c group, although the association was not statistically significant ($p = 0.853$).

Duration of diabetes: The mean duration was 6.01 ± 0.91 years in the normal HbA1c group and 4.38 ± 1.05 years in the raised HbA1c group, with no significant difference ($p = 0.603$).

HbA1c distribution overall: Most patients had HbA1c levels between 6-7% (80 patients, 61.54%), while 25 patients (19.23%) had HbA1c 4-5% and 25 patients (19.23%) had HbA1c >= 8%.

Postoperative sternal wound infection: Overall SWI was observed in 10/130 patients (7.69%). Infection was significantly lower in the normal HbA1c group (2/65, 3.08%) compared with the raised HbA1c group (8/65, 12.31%). This difference was statistically significant ($p = 0.048$).

Stratification by HbA1c level: No infection occurred in patients with HbA1c 4-5%. Infection occurred in 2/80 patients (2.50%) with HbA1c 6-7%. The highest infection frequency was observed in patients with HbA1c >= 8%, where 8/25 patients (32.00%) developed infection.

Table 1. Distribution of patients by age

Age group	Normal HbA1c n (%)	Raised HbA1c n (%)
21-30 years	1 (1.54%)	0 (0.00%)
31-40 years	2 (3.08%)	1 (1.54%)
41-50 years	7 (10.77%)	7 (10.77%)
51-60 years	13 (20.00%)	19 (29.23%)
61-70 years	37 (56.92%)	35 (53.85%)
71-80 years	5 (7.69%)	3 (4.62%)
Mean ± SD	62.41 ± 1.09	61.96 ± 2.64

Table 2. Baseline characteristics

Variable	Normal HbA1c	Raised HbA1c
Number of patients	65	65
Male, n (%)	34 (52.31%)	39 (60.00%)
Female, n (%)	31 (47.69%)	26 (40.00%)
Mean BMI (kg/m²)	28.98 ± 2.46	32.61 ± 1.98
BMI >= 30 kg/m², n (%)	12 (18.46%)	37 (56.92%)
Mean diabetes duration (years)	6.01 ± 0.91	4.38 ± 1.05

Table 3. HbA1c distribution overall

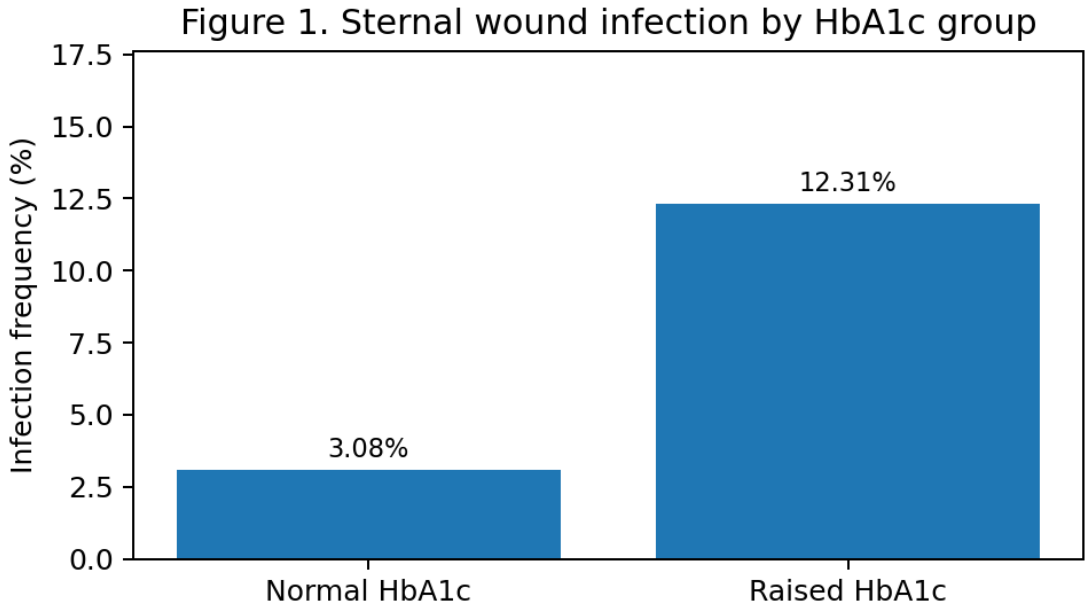
HbA1c level	Number of patients	Percentage
4-5%	25	19.23%
6-7%	80	61.54%
>= 8%	25	19.23%

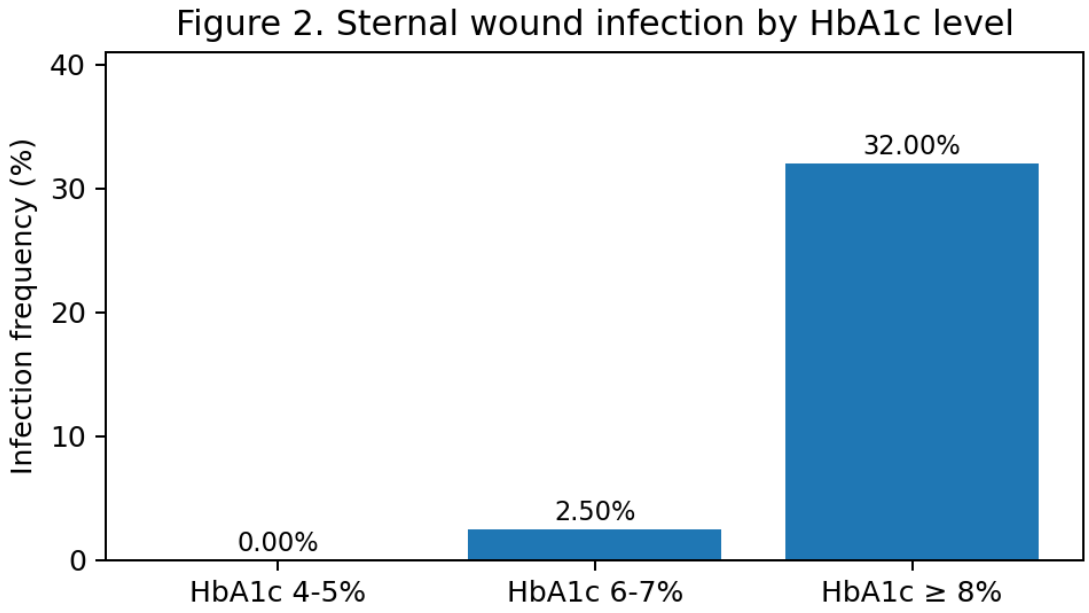
Table 4. Postoperative sternal wound infection by HbA1c group

Infection status	Normal HbA1c (n=65)	Raised HbA1c (n=65)	Total (n=130)
Yes	2 (3.08%)	8 (12.31%)	10 (7.69%)
No	63 (96.92%)	57 (87.69%)	120 (92.31%)

Table 5. Infection frequency by HbA1c level

HbA1c level	Infection n/N	Infection frequency
4-5%	0/25	0.00%
6-7%	2/80	2.50%
>= 8%	8/25	32.00%





DISCUSSION

The present study demonstrated that raised HbA1c was associated with a significantly higher frequency of postoperative sternal wound infection after CABG. The overall infection frequency was 7.69%, while infection occurred in 3.08% of patients with normal HbA1c and 12.31% of patients with raised HbA1c. This difference was statistically significant ($p = 0.048$), indicating that poor preoperative glycemic control is an important clinical marker for postoperative wound infection risk in diabetic CABG patients. The association between hyperglycemia and wound infection is biologically plausible. Hyperglycemia impairs neutrophil chemotaxis, phagocytosis, oxidative killing, tissue oxygenation, and collagen deposition, all of which are essential for wound healing [16-18]. In cardiac surgery, median sternotomy creates a large surgical wound that depends on adequate vascular supply, immune function, and stable metabolic control for healing.

In this study, infection frequency was highest in patients with HbA1c >= 8% (32.00%). This suggests a clinically important dose-related pattern. Previous studies have also reported increased risk of SWI and adverse outcomes in patients with elevated preoperative HbA1c levels [19-21]. The role of obesity was clinically relevant. Infection was more frequent among obese patients with raised HbA1c. Obesity may increase SWI risk because adipose tissue has relatively poor vascularity, lower oxygen

tension, increased wound tension, and reduced antibiotic penetration [22]. Although the BMI association was not statistically significant in this study, the observed clinical pattern supports careful wound care in obese diabetic patients undergoing CABG.

Although age, gender, BMI, and duration of diabetes showed clinical trends, their stratified associations were not statistically significant. This may be explained by the relatively small number of infected cases. However, the main comparison between normal and raised HbA1c remained statistically significant, supporting HbA1c as a practical preoperative risk stratification marker [23].

Current cardiac surgery guidelines emphasize perioperative glucose control, antimicrobial prophylaxis, sterile surgical technique, and postoperative wound surveillance [24-26]. These recommendations support the clinical importance of identifying high-risk patients before surgery and optimizing glucose control where clinically possible.

PRACTICAL IMPLICATIONS

- HbA1c should be routinely assessed in all diabetic patients planned for elective CABG.
- Patients with raised HbA1c, especially >= 8%, should be considered at high risk for postoperative SWI.
- Elective cases may benefit from preoperative glycemic optimization where clinically feasible.
- Patients with both raised HbA1c and obesity should receive closer postoperative wound monitoring.

CONCLUSION

Raised HbA1c is significantly associated with increased frequency of sternal wound infection after CABG in diabetic patients. In this study, postoperative SWI occurred in 10/130 patients (7.69%): 2/65 (3.08%) with normal HbA1c versus 8/65 (12.31%) with raised HbA1c ($p = 0.048$). The highest infection frequency was seen in patients with HbA1c >= 8% (32.00%). These findings support routine preoperative HbA1c testing, better diabetic optimization, strict perioperative glucose control, and close wound surveillance in diabetic patients undergoing elective CABG.

RECOMMENDATIONS

- Preoperative HbA1c should be checked in all diabetic patients planned for elective CABG.
- Patients with raised HbA1c should receive glycemic optimization before surgery where clinically possible.
- Patients with HbA1c >= 8% should be considered at particularly high risk for postoperative sternal wound infection.
- Cardiac surgery units should use standardized perioperative glucose-control protocols, appropriate antibiotic prophylaxis, strict aseptic technique, and structured postoperative wound follow-up.
- Future studies should separate superficial and deep sternal wound infection and use multivariable analysis to identify independent predictors.

LIMITATIONS

This was a single-center study, so findings may not be generalizable to all cardiac surgery settings. Follow-up was limited to 21 postoperative days. The study did not separately classify superficial and deep sternal wound infection. The number of infected patients was small, which may explain why some stratified associations were clinically important but statistically non-significant. Multivariable regression analysis was not performed.

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