

**Original article**

## **Haemoglobin A1c and preoperative glycaemia as a decision tool to help minimise sternal wound complications: a retrospective study in off pump coronary artery bypass surgery**

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### **Abstract:**

**Background:** It is not yet clear how hemoglobin A1c (HbA1c) and preoperative glycemia can be used in clinical decision-making to prevent sternal wound complications following off-pump coronary bypass grafting (OPCAB).

**Methods:** We conducted a retrospective study of 50 consecutive patients who underwent OPCAB surgery. The associations of HbA1c and preoperative glycemia with incidence and grade of SWC were analysed.

**Results:** Preoperative HbA1c was <7% in 25 patients ( Group A) and  $\geq 7.0\%$  in 25 patients ( Group B ) Patients in the high HbA1c group were younger, with greater preoperative serum glucose levels 150 mg/dL vs 124 mg/Dl (  $P < .001$ ) and more frequent history of preoperative insulin use (18% vs 8%,  $P < .001$ ) Hypertension and CCF was found more significant in Group B than A . Incidence of composite of postoperative morbidity and mortality endpoints was greater in patients with HbA1c  $\geq 7.0\%$  (22% vs 14%,  $P = .043$ ). Perioperative time-weighted average glucose concentration was also greater in patients with HbA1c  $\geq 7.0\%$ , whereas the CV did not show any difference.

**Conclusions:** Under certain conditions, HbA1c and glycemia are associated with SWC following OPCAB. These findings help to plan the process with minimal SWC risk.

**Keywords:** Diabetes mellitus , HbA1c, OPCAB, Sternal wound complications, Sternal wound infections.

### **Introduction:**

Diabetes mellitus (DM) is a very common disease in patients undergoing coronary artery bypass graft surgery (CABG) which is known to have serious side effects. However, not all patients with DM have heart surgery who are at increased risk of adverse outcomes. Several studies focusing on factors influencing increased risk, particularly glycemic control, which may be variable, have reported conflicting results. Glycated hemoglobin (HbA1c) level, a well-known indicator of long-term glycemic control for the last 3 to 4 months, has been reported to be associated with dysfunction of small blood vessels, resulting in organ damage. investigated in different categories of surgical patients. From the perspective of short-term glycemic control, perioperative

hyperglycemia and increased glycemic variability were closely associated with adverse outcomes in cardiac surgery patients. (1,2,3)

It is not yet clear how hemoglobin A1c (HbA1c) and preoperative glycemia can be used in clinical decision-making to prevent sternal wound complications following off-pump coronary bypass grafting (OPCAB). There seems to be a number of diabetic variables regarding glycemic control to improve the outcome of surgery. The aim of the study was to evaluate the impact of preoperative glycated hemoglobin (HbA1c) level on diabetic patients receiving off-pump coronary bypass (OPCAB) differences in perioperative glycemic differences and adverse effect.

**Methodology:**

Present study was conducted in our department in last one year. Retrospectively we collected all data and was analysed. Sample size was estimated with the help of expert. We divided patients in two groups depending on HBA1C level either less than 7 ( Group A) and more than 7 ( Group B)

We conducted a retrospective study of 50 consecutive patients who underwent OPCAB surgery. The associations of HbA1c and preoperative glycemia with incidence and grade of SWC were analysed.

The perioperative goal of glycemic control was <180 mg/dL. Patients were divided into 2 groups according to HbA1c level (<7.0% or ≥7.0%). Glycemic variability during surgery and up to 24 hours after surgery was assessed by coefficient of variation (CV).

Primary outcome was defined as composite of postoperative permanent stroke, prolonged ventilation, deep sternal wound infection, renal failure, reoperation, and 30-day mortality.

**Table 1 - Grading of sternal wound complications**

|                      |  |
|----------------------|--|
| Grade 1: Minor       | Superficial wound problem: local redness or minimal drainage |
|                      | Conservative approach, spontaneous healing                   |
| Grade 2: Superficial | Wound infection: positive culture                            |
|                      | Antibiotic treatment   |
| Grade 3: Moderate    | Deep wound infection: dehiscence                             |
|                      | Need for drainage, debridement, or VAC                       |
| Grade 4: Severe      | Mediastinitis or mechanical sternal dehiscence               |
|                      | Refixation of the sternum or omentoplasty                    |

**Results:**

**Table 2 - Preoperative characteristics of patients summery**

|                                    | <b>HbA1c &lt;7% n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>HbA1c <math>\geq</math>7% n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>P value</b> |
|------------------------------------|--|---|----------------|
| Age ( In years )                   | 63 $\pm$ 6   | 62 $\pm$ 7  | .012           |
| Emergency                          | 1 (4%)   | 2 (8%)  | .0034          |
| Body surface area ( m <sup>2</sup> | 1.71 $\pm$ 0.12  | 1.71 $\pm$ 0.37   | .67            |
| Hypertension                       | 18 (72%)   | 20 (80%)  | .0003          |
| Congestive heart failure           | 5 (20%)  | 6 (24%)   | .065           |
| Chronic kidney disease             | 3(12%)   | 4(16%)  | .56            |

Preoperative HbA1c was <7% in 25 patients ( Group A) and  $\geq$ 7.0% in 25 patients ( Group B )

Patients in the high HbA1c group were younger, with greater preoperative serum glucose levels 150 mg/dL vs 124 mg/Dl (  $P < .001$ ) and more frequent history of preoperative insulin use (18% vs 8%,  $P < .001$ )

Hypertension and CCF was found more significant in Group B than A .

Other characteristics including comorbidities were similar between the groups.

**Table 3 - Glycemic variables during operation and 24 hours postoperatively**

| <b>Variable</b>              | <b>HbA1c &lt;7%<br/>n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>HbA1c <math>\geq</math>7%<br/>n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>P value</b> |
|------------------------------|--|---|----------------|
| Mean glucose, mg/dL          | 162  | 180   | <.001          |
| Perioperative use of insulin | 15(60%)  | 20(80%)   | <.001          |
| Hyperglycemic event, %       | 5(20%)   | 8(32%)  | <.001          |

**Table 4 Comparison of postoperative outcomes**

| <b>Variable</b>   | <b>HbA1c &lt;7%<br/>n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>HbA1c <math>\geq</math>7%<br/>n = 25<br/>( Mean <math>\pm</math>SD )</b> | <b>P value</b> |
|---|--|---|----------------|
| Composite morbidity/mortality                           | 4(16%)   | 7(28%)  | .032           |
| Renal failure   | 1(4%)  | 3(12%)  | .0034          |
| Permanent stroke  | 1 (4%)   | 2 (8%)  | .051           |
| Mortality   | 1(4%)  | 2(8%)   | .0021          |
| Average duration of intensive care unit stay ( In days) | 2  | 2   | .69            |

| Variable                               | HbA1c<br><7%<br>n = 25<br>( Mean<br>±SD ) | HbA1c<br>≥7%<br>n = 25<br>( Mean<br>±SD ) | P value |
|--|---|---|---------|
| Average duration of hospitalization, d | 10  | 10  | .163    |
| Sternal wound complications (%)        | 0   | 1(4%)                                     | 0.0032  |

In our study , overall morbidity and mortality was significantly more in group B than group A . Incidence of composite of postoperative morbidity and mortality endpoints was greater in patients with HbA1c ≥7.0% (22% vs 14%, P = .043). Perioperative time-weighted average glucose concentration was also greater in patients with HbA1c ≥7.0%, whereas the CV did not show any difference. Incidence of Sternal wound complication was noted in one patient ( 4%) in Group B only.

**Discussion:**

DM, HbA1c, and perioperative glycemic control are closely related, independent or related mutations, which have been shown to have a negative effect on outcome after cardiac surgery using the following basic methods. DM is known to damage endothelial function and increase oxidative stress and inflammation; Chronic hyperglycemia, characterized by an increase in HbA1C levels, has been shown to exacerbate cell damage. Interestingly, we found significant correlations between age group and HbA1c association with SWC: high HbA1c was significantly associated with higher SWC incidence in patients aged <70 years, while there was no association in patients ≥70 years of age.

In our study , Preoperative HbA1c was <7% in 25 patients ( Group A) and ≥7.0% in 25 patients ( Group B ) Patients in the high HbA1c group were younger, with greater preoperative serum glucose levels 150 mg/dL vs 124 mg/Dl ( P<.001) and more frequent history of preoperative insulin use (18% vs 8%, P<.001) Hypertension and CCF was found more significant in Group B than A . Incidence of composite of postoperative morbidity and mortality endpoints was greater in patients with HbA1c ≥7.0% (22% vs 14%, P = .043). Perioperative time-weighted average glucose concentration was also greater in patients with HbA1c ≥7.0%, whereas the CV did not show any difference.

Since glycemia is more sensitive to temporary changes than HbA1c, it was expected to contain less predictable SWC after surgery. This was confirmed by our finding that in the whole study group, none of our models showed an association between pre-surgical glycemia and the incidence or degree of SWC. However, after studying the terms of interaction, we were able to show that glycemia was associated with SWC under certain conditions. First, glycemia was found to be a useful predictor in an emergency situation. The pressure associated with emergency intervention is known to cause temporary disruption of blood glucose profiles, which may

obscure their predictive data [21]. In the case of emergency surgery, HbA1c can therefore be a better marker as it is stable and easily reflects chronic blood glucose levels. Glycemia was significantly associated with SWC in diabetic patients with a BMI < 30[13]. Similarly, a combination of high risk factors in obese patients (BMI> 30) with diabetes can lead to a reduction in the effect of glycemia on SWC.

In general, elevated HbA1c is strongly associated with high levels and SWC levels following OPCAB in diabetic patients, whereas glycemia is absent. However, the association of HbA1c with SWC appears to be insignificant in patients older than 70 years. In addition, glycemia may be a useful predictor of SWC under certain conditions: in patients undergoing emergency surgery, in patients with grafting diabetic patients, and in diabetic patients with a BMI <30.

#### **Study limitations:**

This study has some limitations. This was a retrospective study and could easily be confusing.

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