

## Effect of HBA1C level on Post-Operative complications post cardiac surgery

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### ABSTRACT

**Introduction:** The American Diabetes Association (ADA) recommends Glycated Hemoglobin (HbA1c) for assessing long-term glycemic control in diabetic patients.

**Aim of the Work:** To assess the effect of HbA1c level on post cardiac surgery complications.

**Methodology:** In our study, we sought to assess the effect of HbA1c level on post cardiac surgery complications. The study comprised 40 patients, who were initially classified according to their glycemic control status with HbA1c cut off value of 7% into 2 groups, 20 patients in each group (group 1 HbA1c <7%; Group 2 HbA1c >7%). Of all included patients, regardless of the HbA1c level, 25 patients (62%) were previously known to be diabetics, 8 (48%) were discovered to be diabetic on pre-operative assessment, and 7(17.5%) were non-diabetics. To evaluate the effect of HbA1c rather than diabetes per se, we further sub-grouped our patients into 4 groups, Non diabetics, known diabetics with good control or those with poor control, and those accidentally discovered with poor control.

**Results:** The main findings of our study showed that patients with HbA1c> 7% had a significantly higher occurrence both major and minor complications. Specifically, group 2 had a higher occurrence of post-operative LV dysfunction, higher incidence of DKA, high base deficit and lactate as early post-operative complications; and more wound infection, and prolonged MV, with more patients requiring ICU stay for more than 3 days as late post-operative complication. Moreover, when considering the previous history of diabetes, known diabetic uncontrolled patients had the highest incidence of complications, while controlled diabetic patients had a significantly lower incidence of complications than those accidentally discovered and similar to non-diabetic patients. Finally, HbA1c level positively correlated with S. lactate, and a cut value of 6.7% was predictive of post-operative complication with a sensitivity of 85% and specificity of 78%.

**Conclusion:** Glycated Hb is an important predictor for minor and major complications occurring early or late post cardiac surgery, the control of blood sugar is a more important than the diabetic history, per se, in predicting post-cardiac surgery complication.

**Key words:** CABG (coronary artery bypass graft), HbA1c (glycated hemoglobin), DKA (diabetic ketoacidosis).

### INTRODUCTION

The American Diabetes Association (ADA) recommends Glycated Hemoglobin (HbA1c) for assessing long-term glycemic control in diabetic patients (*Thourani VH. et al*), Because the red cell turnover has a life span of 90-120 days, HbA1c is not affected by short-term fluctuations and hence allows better assessment of blood sugar control over 3-4 months. For optimum glycemic control, the ADA recommends a target HbA1c of less than 7%, whereas HbA1c levels between 4-6% are considered normal and associated with reduced incidence of complication (Diabetes Care 2005;28 (Suppl 1):4-36).

#### Aim of the Study:

Primary goal: To assess the effect of HbA1c level on post cardiac surgery complications.

Secondary goal: to detect if HbA1c is an important predictor for minor and major complications occurring early or late post cardiac surgery.

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## PATIENTS AND METHODS

The study comprised 40 patients, who were initially classified according to their glycemic control status with HbA1c cut off value of 7% into 2 groups, 20 patients in each group (group 1 HbA1c <7%; Group 2 HbA1c >7%). Of all included patients, regardless of the HbA1c level, 25 patients (62%) were previously known to be diabetics, 8 (48%) were discovered to be diabetic on pre-operative assessment, and 7(17.5%) were non-diabetics. To evaluate the effect of HbA1c rather than diabetes per se, we further sub-grouped our patients into 4 groups, Non diabetics, known diabetics with good control or those with poor control, and those accidentally discovered with poor control.

Our population above 18 years old who were admitted for open-heart surgery including coronary artery bypass graft (CABG) and valve replacement surgery were included in the study, all the patients were subjected to History taking, physical examination, routine Investigation and Lab evaluation including Hba1c level according to ICU protocol, then Followed up for post-operative complication daily during the study period till discharge, Aiming to proving that Hba1c level is very important as indicator for post cardiac surgery complication or morbidity and finding correlation between Hba1c level and patient outcome whom candidate of cardiac surgery.

### Statistical Analysis:

Statistical analysis of our study was conducted, by *IBM SPSS statistics*® version.24 and some add-ins of *Microsoft excel*® 2013 (*XLSTAT*® version 18.07.39066 and *Real-Statistics Analysis Tool*®). P value <0.05 was considered statistically significant.

## RESULTS

By comparing the demographics and baseline clinical data between both groups, we could not find a significant difference regarding age, gender, or family history. There was also no difference in renal impairment or incidence of LV dysfunction. However, regarding the risk factors for CAD, although there was no significant difference in the incidence of smoking or dyslipidemia, yet there was significantly more patients having diabetes mellitus since all group 2 patients were diabetic with HbA1c of  $8.58 \pm 1.47\%$  [either previously known (30% of patients with a mean HbA1c of  $8.48 \pm 1.16\%$ ), or accidentally discovered (20% of patients with a mean HbA1c of  $7.93 \pm 1.05\%$ )]. On the other hand, group 1 patients (HbA1c  $6.51 \pm 0.39\%$ ) were either non-diabetic (17.5% of patients with a mean HbA1c of  $6.16 \pm 0.53\%$ ) or well controlled diabetic patients (32.5% of patients with a mean HbA1c  $6.23 \pm 0.45\%$ ), and systemic hypertension in group 2, Group 2 patients also had more coronary vessels affected than patients in group 1, however this difference was not statistically significant. Importantly, there was no significant difference in the Euro score between both groups.

The complications in our patients, whether early or late postoperatively, were also classified into Major (life threatening or life- long morbidity), or minor (non-life threatening) complications. Major complication included shock, systolic dysfunction, myocardial infarction, stroke, wound infection and sternal dehiscence, while minor complication included DKA, high base deficit, high lactate level, arrhythmias, prolonged stay on MV, prolonged ICU stay, and prolonged hospital stay.

The main findings of our study showed that patients with HbA1c  $\geq 7\%$  had a significantly higher occurrence both major and minor complications. Specifically, group 2 had a higher occurrence of post-operative LV dysfunction, higher incidence of DKA, high base deficit and lactate as early post-operative complications; and more wound infection, and prolonged MV, with more patients requiring ICU stay for more than 3 days as late post-operative complication. Moreover, when considering the previous history of diabetes, known diabetic uncontrolled patients had the highest incidence of complications, while controlled diabetic patients had a significantly lower incidence of complications than those accidentally discovered and similar to non-diabetic patients. Finally, HbA1c level positively correlated with S. lactate, and a cut value of 6.7% was predictive of post-operative complication with a sensitivity of 85% and specificity of 78%.

## DISCUSSION

Firstly Patients with uncontrolled diabetes are more prone to chronic diabetes complications especially vascular ones. Consistent with that fact, group 2 patients had a higher number of coronary vessels affected ( $3.1 \pm 1.76$ ) compared to those in group 1 ( $2.2 \pm 1.87$ ); yet this difference was not significant (p 0.1). However, among the 4 subgroups, the incidence of multi-vessel disease was significantly higher in the uncontrolled diabetic patients.

Our study showed a highly significant occurrence of early post-operative LV systolic dysfunction, DKA, high base deficit and lactate in patients of group 2 compared to those of group 1, as an early post-operative complication.

The higher occurrence of LV dysfunction in patients of group 2 not only indicates the possible vascular affection on group 2 patients, but may also highlight the possible acute effect of blood sugar variation with cellular edema that occurs in uncontrolled patients.

The occurrence of stress induced elevation of blood sugar in these patients, added to the uncontrolled diabetes status in the preoperative period resulted in the higher incidence of post-operative DKA and high (non-renal) base deficit. Another explanation high HbA1c in those patients despite therapy may be an indication of be an indicator of poor tissue sensitivity to Insulin that easily progresses into stress induced DKA Similarly, SATO, et, al, Our findings are also in concordance with study kawahito, et.al.

We could not find any difference between both groups regarding the occurrence of MI or Arrhythmias. Although

patients of group 2 had a higher, but statistically insignificant, occurrence of shock, yet when comparing the 4 subgroups, poorly controlled diabetic patients had a significantly higher occurrence of LV dysfunction, lactate levels and 3 of whom required IABC insertion, but the occurrence of shock per se could not reach statistical significance due to the limited number of patients as (Lazar, HL, 2012), In contrary to our findings regarding MI, (knapik and associates in 2011).

Regarding the occurrence of arrhythmia, there was no significant difference among both group; where AF was the most common arrhythmia found in our patients (15/18), These findings regarding arrhythmias is consistent with the study by (Kinoshita and colleagues in 2011).

Our results showed that group 2 patients had a significantly higher incidence of wound infection, more prolonged duration on MV and ICU stay as a late post-operative complication; Our findings regarding the infectious complications are in line with that of (Sato and colleagues 2010), On the contrary, (Göksedef and colleagues in 2008; Gurrapu et al, 2017) studied 150 patients undergoing CABG.

In line with (knapik and colleagues), we could not find any significant difference between both groups in the incidence of sternal dehiscence, stroke, or ICU mortality.

However, both the duration of MV and ICU stay were significantly longer in group 2 patients as compared to group 1 (28.2±78.6 vs 5.59±2.1 hrs, and 4.7±4.2 and 3.3±1.8 days respectively. Group D (Known diabetic uncontrolled patients) stayed the longest (42.2±10.1 hrs, and 5.75±5.1 days). The longer duration on MV and ICU stay could both be explained by more incidences of shock, infection, DKA, and harder control of their blood sugar levels, as (Lazar, HL, 2012) and McGinn Jr, et.al).

## CONCLUSION

- Glycated Hb is an important predictor for minor and major complications occurring early or late post cardiac surgery.
- The control of blood sugar is more important than the diabetic history, per se, in predicting post-cardiac surgery complication.
- Similar to the recommendations for tight perioperative glycemic control, this study extends such recommendation to optimum blood sugar control to the 3 months preoperatively guided by HbA1c.
- A target level for HbA1c level  $\leq 6.7$  should be pursued in candidates for cardiac surgery. To improve outcome, deferring cardiac surgery in poorly controlled patients may be warranted until such level is approximated.
- Larger multicenter studies are needed to further define the role of insulin sensitivity in predicting post-operative complications and ultimate outcome.

Authors declare that there is no conflict of interests regarding the publication of this paper.

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## Conflicts of Interest