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Original Article

Impact of elevated glycosylated hemoglobin on hospital outcome and 1 year survival of primary isolated coronary artery bypass grafting patients

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ABSTRACT

Objective: It is unknown whether adequacy of diabetic control, measured by hemoglobin A1c, is a predictor of adverse outcomes after coronary artery bypass grafting.
Methods: From December 2013 to November 2015, 80 consecutive patients underwent primary isolated CABG surgery at national heart institute, their data were prospectively collected and they were classified according to their HbA1c level into two groups, Group (A): Forty patients with fair glycemic control (HbA1c below or equal to 7%), Group (B): Forty patients with poor glycemic control (HbA1c above 7%). Hospital morbidity, mortality and one year survival were examined in both groups. Telephone conversation was used to call patients or their relatives to determine the one year survival and it was 100% complete. This study had gained the ethical approval from national heart institute ethical committee.
Results: In-hospital mortality for group A was 2.5% (one patient) and 7.5% (3 patients) for group B with no statistical significance. One year mortality was (5.13%) (2 patients for group A) and (8.11%) (3 patients) for group B with no statistical significance. As regard the morbidity there was no statistical significance between the two groups in the incidence of neurological complications whether stroke or coma, atrial fibrillation, postoperative myocardial infarction, low cardiac output syndrome, heart failure, renal failure, need for dialysis, deep sternal wound infection, and readmission. However, group B had lengthy hospital stay, lengthy ventilation hours, more respiratory complications, and more superficial wound infection with a statistical significance when compared to group A, P values were 0.003, 0.003, 0.038, 0.044 respectively.
Conclusions: This study showed that HbA1c is a good predictor of in-hospital morbidity. It worth devoting time and effort to decrease HbA1c level below 7% to decrease possible postoperative complications.
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1. Introduction

Diabetes mellitus (DM) is known to be a risk factor for the development and progression of cardiovascular disease (CVD). 55% of the diabetic population have coronary artery disease (CAD). It is well known that diabetes is a major independent risk factor for IHD after adjustment for other risk factors such as age, hypertension, hypercholesterolemia, and smoking.[1] Approximately from all coronary artery bypass grafting (CABG) population, 20% of them have DM. Thus, diabetic patients undergoing this operation represent a large and complex patient population.[1]

In 2011, the World Health Organization advocated the use of HbA1c in diagnosing diabetes. Irrespective of previous diabetic status, elevated HbA1c acts as a strong predictor of both morbidity and mortality. In particular, it was estimated that the mortality risk for CABG is quadrupled at HbA1c levels >8.6%. In elective situations, these patients should be delayed for surgery until adequate levels of HbA1c which reflects proper glycaemic control is achieved.

The predictive value of HbA1c had been investigated on short-term outcomes in well-controlled diabetes in some recent studies.[2] HbA1c reflects a patient's glucose control during the preceding

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3–4 months. According to Current practice guidelines of the American Diabetes Association,[3] current recommendations suggest that patients with diabetes aim to achieve HbA1c levels of at least less than 7%.[4–6] This study will show whether or not HbA1c, the standard measure to assess long-term glucose control, is a potential risk factor for adverse outcomes in patients undergoing CABG.

2. Materials and methods

From December 2013 to November 2015, 80 consecutive patients underwent primary isolated CABG surgery at National Heart Institute, their data were prospectively collected and they were classified according to their HbA1c level into two groups,

Group (A): Forty patients with fair glycemic control (HbA1c below or equal to 7%).

Group (B): Forty patients with poor glycemic control (HbA1c above 7%). Patients of group B were operated upon semiurgently because of left main disease or successfully treated unstable angina after weaning from IV medications and all of them were stable enough for discharge but having no time to correct HbA1c fully.

2.1. The inclusion and exclusion criteria of the study groups were

2.1.1. Inclusion criteria

Adult patients undergoing elective first time CABG surgery in cases of:

(1) Multi-vessel coronary artery disease.
(2) Left main disease.
(3) One or two coronary vessel disease.

2.1.2. Exclusion criteria

Adult patients with the following diseases:

(1) Patients with multiple preoperative co-morbidities (liver failure, renal failure, respiratory failure and advanced malignancy).
(2) Patients with history of previous cerebro-vascular disease.
(3) Patients with concomitant Valvular heart disease

2.2. Operative technique

2.2.1. Anesthesia

Before surgery all preoperative medications were continued until the morning of surgery except for angiotensin-converting enzyme inhibitors and angiotensin 2 receptor blocker. They were discontinued at the night of surgery. Acetylsalicylic acid was discontinued 5 days before surgery, clexane 12 h before operation and plavix from 5–7 days before operation. Moreover, all patients were pre-medicated with oral valium (5 mg) at the night of surgery then intramuscular Morphin (l0 mg) at the morning of surgery and intravenous midazolam (0.1 mg/kg) at the operating room.

After admission to the operating room, patients were monitored with five-lead electrocardiogram (leads ii and v simultaneously), pulse oximetry, invasive arterial blood pressure using an arterial catheter connected to a pressure transducer, capnography, central venous catheter inserted in the internal jugular vein, nasopharyngeal temperature probe, urinary catheter and frequent arterial blood gases measurements.

After pre-oxygenation, general anesthesia was induced with thiopental (3–5 mg/kg), Fentanyl (2–10 mg/kg) and pancuronium (0.1 mg/kg). Patients were then ventilated manually with face mask and intubated with an oral cuffed endotracheal tube with the proper diameter, followed by the onset of controlled mechanical ventilation.

Anesthesia was maintained with isoflurane and additional doses of propofol infusion, fentanyl (1–2 ugm) and pancuronium (0.01 mg/kg). Anticoagulation was established with an initial dose of heparin (300–400 IU/kg) and to get activated clotting time (ACT) high than 400 s., additional heparin was given on need to maintain ACT higher than 400 s. during bypass time.

2.2.2. Surgery

All patients were operated via median sternotomy and cardiopulmonary bypass with aorto-caval cannulation. Heart was cross clamped and plegied by warm blood intermittent antegrade cardioplegia. Left internal mammary artery was anastomosed to left anterior descending artery. Reversed saphenous vein was anastomosed to other target vessels. Patients were subjected to perioperative tight glycemic control using uniform intravenous insulin infusion protocol (target blood glucose level below 150 mg/dl). Patients were compared regarding morbidity and mortality. Also, one year survival was compared.

All patients were treated with a uniform perioperative intravenous insulin protocol. In the operating room, an insulin infusion was prepared by mixing 100 units of insulin with 50 mL 0.9% normal saline. Routine measurement of blood glucose was obtained from serial arterial blood samples measured every 15minutes.

In the intensive care unit, glucose levels were obtained from arterial blood samples or finger stick samples every 2 h. Patients received a continuous insulin infusion that was adjusted to maintain blood glucose below 150 mg/dl. Once patients were transferred to the floor, blood glucose values were obtained every 4 to 6 h. The insulin infusion was initiated only for blood glucose more than 200 mg/dL and adjusted to target of blood glucose below 150 mg/dL. If level is below 200 mg/dl, blood glucose management was variable and includes combination of scheduled subcutaneous insulin therapy, and repeated insulin injections according to Matias protocol.

3. Results

Demographic criteria of the two groups are listed in Table 1 that demonstrates that the incidence of left main disease and dysnea was higher in group B (HbA1c above 7%) with p value of 0.022 and 0.043 respectively.

In this study, the incidence of left main disease is higher in group B (37.5%) compared to (15%) of group A, p value of 0.02, owing to the fact that most of them needs semiurgent surgery leaving less chance of better glycemic control preoperatively. Therfore, surgery had not been canceled because of high hbA1c, but little time was given to correct blood sugar tightly aiming at blood glugose level less than 150 mg/dl for all in hospital transfer patients before surgery. This group was successfully treated from ACS in the form of unstable angina or had a critical anatomy of LMD along with their symptoms.

The operative details of the studied groups are also listed in Table 1 that shows introperative difficulty in controlling blood glucose level in group B compared to group A both during and after cross clamp time. This led to a significant increase in cardiopulmonary bypass and total operative times in group B, p value of 0.000 and 0.003 respectively. Moreover, the incidence of intraoperative acidosis was significantly higher in group B and was more difficult to control. In this study acidosis was considered persistent when metabolic acidosis was not responding to usual measures of treatment such as Na Hco3 and this in turn could lead to cardiac arrhythmais and decreased response to inotropes like epinephrine.

In this study all patients received insitu pedicled LIMA to LAD except for one patient in group B due to inadvertent injury to LIMA conduit that had been replaced by reversed saphenous vein graft to

Table 1
Demographic criteria and Operative details of the studied groups.

			HbA1c < 7	HbA1c > 7	Independent *t*-test		
			Group A	Group B	t/X^2	P-value	Sig.
Age (years)	Mean ± SD		58.52 ± 6.70	56.27 ± 5.82	0.023	0.113	NS
	Range		40–72	38.00–67			
Sex	Female		11 (27.5%)	8 (20.0%)	0.621	0.431	NS
	Male		29 (72.5%)	32 (80.0%)			
Smoking	Negative		21 (52.5%)	22 (55.0%)	0.050	0.823	NS
	Positive		19 (47.5%)	18 (45.0%)			
DM	1		11 (27.5%)	15 (37.5%)	0.912	0.340	NS
	2		29 (72.5%)	25 (62.5%)			
HTN	Negative		16 (40.0%)	12 (30.0%)	0.879	0.348	NS
	Positive		24 (60.0%)	28 (70.0%)			
COPD	Negative		38 (95.0%)	36 (90.0%)	0.721	0.395	NS
	Positive		2 (5.0%)	4 (10.0%)			
PVD	Negative		37 (92.5%)	37 (92.5%)	0.000	1.000	NS
	Positive		3 (7.5%)	3 (7.5%)			
MI	None		26 (65.0%)	26 (65.0%)	0.848	0.654	NS
	Positive		14 (35.0%)	14 (35.0%)			
EF (%)	Mean ± SD		54.53 ± 5.09	54.13 ± 4.76	0.084	0.718	NS
	Range		42–62	44–64			
LMD	Negative		34 (85.0%)	25 (62.5%)	5.230	0.022	S
	Positive		6 (15.0%)	15 (37.5%)			
No. of vessels	1		2 (5.0%)	0 (0.0%)	4.040	0.133	NS
	2		25 (62.5%)	20 (50.0%)			
	3		13 (32.5%)	20 (50.0%)			
NYHA	1		12 (30.0%)	4 (10.0%)	6.286	0.043	S
	2		26 (65.0%)	30 (75.0%)			
	3		2 (5.0%)	6 (15.0%)			
CCS	1		2 (5.0%)	2 (5.0%)	0.254	0.968	NS
	2		17 (42.5%)	19 (47.5%)			
	3		15 (37.5%)	13 (32.5%)			
	4		6 (15.0%)	6 (15.0%)			
Operative Data							
Intra-operative glucose level							
(a) Intra op g level duringcross clamp time (mg/dl)		Mean ± SD	180.67 ± 26.48	311.96 ± 65.02	24.087	0.000	HS
		Range	140–243	187–467			
(b) Intra op g level aftercross clamp time (mg/dl)		Mean ± SD	138.22 ± 11.62	191.21 ± 52.43	32.122	0.000	HS
		Range	140–243	134.33–350			
Operative time (m)		Mean ± SD	194.65 ± 34.97	218.10 ± 34.28	3.029	0.003	HS
		Range	140–270	155–270			
CBP time (m)		Mean ± SD	67.88 ± 23.96	102.33 ± 27.79	0.508	0.000	HS
		Range	40–120	50–150			
X clamp time (m)		Mean ± SD	34.85 ± 11.88	39.43 ± 9.11	6.463	0.057	NS
		Range	22–60	25–65			
Arterial graft		LAD	40 (100.0%)	39 (97.5.0%)	1.013	0.314	NS
Total grafts		1	1 (2.5%)	0 (0.0%)	10.748	0.013	S
		2	21 (52.5%)	8 (20.0%)			
		3	14 (35.0%)	25 (62.5%)			
		4	4 (10.0%)	7 (17.5%			
Acidosis		No	27 (67.5%)	16 (40.0%)	21.896	0.000	HS
		Not persistent	12 (30.0%)	5 (12.5%)			
		Persistent	1 (2.5%)	19 (47.5%)			
Inotropes		Negative	0 (0.0%)	0 (0.0%)	NA	NA	NA
		Positive	40 (100.0%)	40 (100.0%)			
Noradrenaline		Negative	31 (77.5%)	17 (42.5%)	10.208	0.001	HS
		Positive	9 (22.5%)	23 (57.5%)			

DM: Diabetes mellitus, HTN: Hypertension, COPD: Chronic obstructive pulmonary disease, PVD: Peripheral vascular disease, MI: Myocardial infarction, EF: Ejection fraction, LMD: Left main disease, NYHA: New York Heart Association Functional Classification, CCS: Canadian Cardiovascular Society grading of angina pectoris, Intraoperative glucose level during cross clamp time in mg/dl, Intraoperative glucose level after cross clamp time in mg/dl, CBP time: cardiopulmonary bypass time in minutes, X clamp time: cross clamp time in minutes, NS: Non significant, S: Significant, HS: Highly Significant.

LAD. It was also found the higher need for number of grafts in group B.

All patients needed inotropes on conclusion of the operation but the need for vasopressors (noradrenaline) was significantly higher in group B (23 patients (57.5%) versus 9 patients (22.5%) of group A with p value of 0.001) to control vasoplegia. Thus, it was both the preference of the surgeon and the anesthetist to select noradrenaline when it was felt that the patient is vasodilated or vasoplegic.

Glucose level in the ICU and ward was significantly higher in first four days post operative and became non significantly higher in day five in group B (226.42 ± 53.02) than those of group A (146.72 ± 24.41) with p-value < 0.01, this is illustrated in Table 2.

In-hospital outcome and 1 year survival of the primary isolated CABG performed in the two groups are listed in Table 3. There was no statistically significant difference in the incidence of hospital mortality whether cardiac cause or non cardiac cause, neurological complications whether stroke or coma, atrial fibrillation, postoper-

Table 2
Glucose level control in the ICU and ward.

Glucose level in the ICU		HbA1c < 7	HbA1c > 7	Independent t - Test		
		Group A	Group B	t	P-Value	Sig.
Day zero	Mean ± SD	146.72 ± 24.41	226.42 ± 53.02	25.557	0.000	HS
	Range	120–257	157–350			
Day one	Mean ± SD	130.88 ± 10.84	166.20 ± 40.41	13.873	0.000	HS
	Range	100–163.33	116–360			
Day two	Mean ± SD	122.37 ± 4.87	136.01 ± 8.12	9.111	0.000	HS
	Range	100–141.25	122.5–165			
Day three	Mean ± SD	120.18 ± 4.49	127.47 ± 6.73	5.699	0.000	HS
	Range	97.75–135	100–140			
Day four	Mean ± SD	118.32 ± 5.75	122.18 ± 6.57	2.796	0.065	NS
	Range	75–131.25	97.5–137.5			
Day five	Mean ± SD	117.25 ± 4.32	119.04 ± 5.73	1.578	0.119	NS
	Range	71–125.22	97.5–137.5			

NS: Non significant; HS: Highly Significant

Table 3
Morbidity and hospital mortality plus 1 year survival in the studied groups.

		HbA1c < 7	HbA1c > 7	Chi Square test		
		Group A	Group B	X^2/t	P-Value	
Hospital mortality	Negative	39 (97.5%)	37 (92.5%)	0.263	0.608	NS
	Positive	1 (2.5%)	3 (7.5%)			
Hospital stay (days)	Mean ± SD	6.73 ± 1.94	8.58 ± 2.53	9.554	0.003	HS
	Range	5–15	6–15			
Cardiac causeof mortality	Negative	39 (97.5%)	39 (97.5%)	0.000	1.000	NS
	Positive	1 (2.5%)	1 (2.5%)			
Non cardiac causeof mortality	Negative	40 (100.0%)	38 (95.0%)	2.051	0.152	NS
	Positive	0 (0.0%)	2 (5.0%)			
Neuro com	Negative	40 (100.0%)	39 (97.5%)	1.013	0.314	NS
	Positive	0 (0.0%)	1 (2.5%)			
Stroke	Negative	40 (100.0%)	39 (97.5%)	1.013	0.314	NS
	Positive	0 (0.0%)	1 (2.5%)			
Coma	Negative	40 (100.0%)	39 (97.5%)	1.013	0.314	NS
	Positive	0 (0.0%)	1 (2.5%)			
AF	Negative	34 (85.0%)	30 (75.0%)	1.25	0.263	NS
	Positive	6 (15.0%)	10 (25.0%)			
Post op MI	Negative	38 (95.0%)	37 (92.5%)	0.213	0.644	NS
	Positive	2 (5.0%)	3 (7.5%)			
LCOP	Negative	38 (95.0%)	34 (85.0%)	2.222	0.136	NS
	Positive	2 (5.0%)	6 (15.0%)			
HF	Negative	39 (97.5%)	38 (95.0%)	0.346	0.556	NS
	Positive	1 (2.5%)	2 (5.0%)			
Ventilation hours	Mean ± SD	8.22 ± 8.69	19.23 ± 26.97	9.554	0.003	HS
	Range	3–40	4–144			
Respir. Comp	Negative	34 (85.0%)	26 (65.0%)	4.267	0.038	S
	Positive	6 (15.0%)	14 (35.0%)			
RF	Negative	39 (97.5%)	38 (95.0%)	0.346	0.556	NS
	Positive	1 (2.5%)	2 (5.0%)			
Dialysis	Negative	40 (100.0%)	39 (97.5%)	1.013	0.314	NS
	Positive	0 (0.0%)	1 (2.5%)			
DSWI	Negative	40 (100.0%)	38 (95.0%)	2.051	0.152	NS
	Positive	0 (0.0%)	2 (5.0%)			
Sup w inf	Negative	36 (90.0%)	29 (72.5%)	4.021	0.044	S
	Positive	4 (10.0%)	11 (27.5%)			
Readmission	Negative	40 (100.0%)	38 (95.0%)	2.051	0.152	NS
	Positive	0 (0.0%)	2 (5.0%)			
One year survival	Alive	37 (94.87%)	34 (91.89%)	0.274	0.600	NS
	Died	2 (5.13%)	3 (8.11%)			

Neuro com: Neurological complications, AF: Atrial fibrillation, Hospital stay in days, Post op MI: Postoperative myocardial infarction, LCOP: low cardiac output syndrome, HF: Heart failure, Respir. Comp: Respiratory complications, RF: Renal failure, DSWI: Deep sternal wound infection, Sup w inf: Superficial wound infection, NS: Non significant, S: Significant, HS: Highly Significant.

ative myocardial infarction, low cardiac output syndrome, heart failure, renal failure, need for dialysis, deep sternal wound infection, and readmission between the two groups when compared together.

Low cardiac output state (LCOP) is one form of heart failure and has been used in the paper to describe the clinically manifested heart failure (decompensated) that is transient and usually related to stunning, ischemia reperfusion injury, myocardial protection and use of cardiopulmonay bypass machine and responded to antifailure medications and use of inotropes. Hence, 2 patients of group A (6%) and 6 patients of group B (15%) had LCOP with p value of 0.136.

Heart failure on the other hand is the compensated form that used to describe the high doses of antifailure medications used to control the clinically compensated heart failure e.g. dysnea before discharging the patient and both groups were comparable. Hence, only one patient of group A (2.5%) versus two patients (5%) of group B had heart failure with p value of 0.556.

On contrary, there was a statistically higher incidence of lengthy hospital stay, lengthy ventilation hours, respiratory complications, and superficial wound infection in group B (poor glycemic control (HbA1c above 7%). P values were 0.003, 0.003, 0.038, 0.044 respectively.

As far as one year survival is concerned, 2 (5.13%) patients had died in group A after one year compared to 3 (8.11%) patients in group B with no statistically significant difference between them (p value is 0.600).

4. Discussion

Although HbA1c values had been widely investigated worldwide as a reflective value of long-term blood glucose control and outcome predictor in diabetic patients, its predictive value in the surgical patient population did not receive a good attention.[7]

Improved outcomes in diabetic patients undergoing CABG can be attributed to the changes of CABG practice in the past decade compared with earlier ones, Specifically, the routine use of the left internal thoracic artery,[8] improvements in anesthesia and critical care, the use of off-pump CABG techniques, perioperative insulin infusion,[9–13] and improved secondary prevention protocols,[14] including antiplatelet medication and lipid-lowering regimens. In the present study, we sought to determine whether these outcome differences could be explained by preoperative glycemic control (as measured by HbA1c).

Undoubtedly, one of the most dramatic improvements in outcome among diabetic patients has been the implementation of tight perioperative glucose control. Like we found in our study, Furnary and colleagues[9,12,13] reported dramatic reductions in mortality and DSWI among diabetic patients managed with a continuous insulin infusion initiated intraoperatively and maintained through the first 2 postoperative days. The authors attributed these improvements to enhanced myocardial glycometabolic function associated with euglycemic state achieved by continuous insulin infusion. Our aim in this study was to regulate glucose levels below 150 mg/dL in all patients in the operating room and in the intensive care unit using a continuous insulin infusion.

Once patients were transferred to the ward, management was variable and dependent on their control in the intensive care unit. This included combination of scheduled subcutaneous insulin therapy, and repeated insulin injections according to Matias protocol.[15]

In this study the demographic criteria of the studied groups were comparable with mean age of (58.52 ± 6.70) for group A and (56.27 ± 5.82) for group B with no statistical significance between them. The incidence of left main disease was significantly higher in group B (15 patients (37.5%) compared to 6 patients (15.0%) in group A, p value of (0.02). this higher incidence of left main disease explained the higher need for semiurgent surgery for group B compared to elective one in group A.

Intraoperative insulin resistance and poor preoperative diabetic control had been studied by sato and colleagues who concluded that in diabetic patients preoperative HbA1c levels predict insulin sensitivity during cardiac surgery and, possibly, outcome. Independent of the patient's diabetic state.[7]

In our study intraoperative glucose level was significantly higher in group B than group A both during and after cross clamp time. reflecting difficulty in controlling intraoperative glucose level in group B, a similar finding observed in many studies.[7] This difficulty controlling intraoperative glucose level necessitates longer bypass and total operative time to correct it before conclusion of the operation.

It was also noticed that the number of patients in group B needed higher number of 3, 4 grafts compared to group A. Therefore, 25 patients (62.5%) of group B needed 3 grafts versus 14 patients (35.0%) of group A. Similarly, 7 patients (17.5%) of group B needed 4 grafts versus 4 patients (10.0%) of group A respectively. The higher number of grafts in group B may contribute to longer operative time and reflecting a more aggressive disease in group B.

As far as postoperative myocardial infarction is concerned, level of HbA1c in our study did not increase the incidence of post operative myocardial infarction. This is consistent with the results from Iranian center study by Zahra Faritous et al.[16] but Knapik et al.[17] found a different result as he found a significant increase of postoperative myocardial infarction in patients with high levels of HbA1c.

New onset atrial fibrillation is a common complication post cardiac surgery. In our study HbA1c had no implication on rate of postoperative atrial fibrillation, but Halkos et al.[18] and Kinoshita et al.[19] found that atrial fibrillation rate increased with lower levels of HbA1c.

In concordance with our results, Furnary and Wu,[9] did not identify HbA1c as a risk factor for hospital mortality nor deep sternal wound infection, again similar studies like those done by of Göksedef et al.,[20] Matsuura et al.,[21] Hudson et al.[22] and Alserius et al.[23] concluded that elevated HbA1c has no role in increasing deep sternal wound infection. In contrary to our results, Halkos et al.[18] found a significant increase in rate of deep sternal wound infection with the increase of level of HbA1c.

On other side we concluded that increase of HbA1c level significantly increases the rate of superficial wound infection and along with us Halkos et al.[18], Sato et al.[7] and Alserius et al.[23] found the same result, but Göksedef et al.[20] and Hudson et al.[22] found a different result as they found that elevated HbA1c has no role in increasing rate of superficial wound infection.

In our study we didn't find any significant increased rate of post operative renal failure but Halkos et al.[18] and Hudson et al.[22] found that increased level of HbA1c was associated with increased rate of post operative renal failure.

Again, similar to our results, McGinn in 2011 reported that patients with coronary artery disease are at a high risk for having dysglycemia and there is growing evidence that dysglycemia irrespective of underlying history of diabetes is associated with adverse outcomes in coronary artery bypass graft (CABG) surgery patients, including increased length of stay and wound infections.[24]

In our study we did not find any correlation between HbA1c level and postoperative neurological complications. In sharp contrast to this, results obtained from Halkos et al.[18] showed a significant increase in rate of cerebrovascular stroke with increased level of HbA1c.

At last, the hospital and one year mortality in our study did not show a significant difference between the studied cohorts, one explanation is that we implemented continuous insulin infusion protocol to achieve tight blood glucose level control preoperatively, intraopertively and postoperatively. Another explanation is that more number of patients are needed in both groups to reach a statistical significance in hospital and one year mortality.

This is consistent with results reported by Tsuruta et al.[25], Knapik et al.[17] and Matsuura et al.[21] In contrast to our study, other studies evaluating the impact of diabetes on morbidity and mortality after CABG have resulted in different conclusions like Hudson et al.[22], Halkos et al.[18] and Alserius et al.[24] who found that the increase of HbA1c significantly increases mortality that may reach to four folds when HbA1c increase more than 8.5. However, we still agree with most authors that strict intraoperative and postoperative glucose control is imperative to minimize both postoperative morbidity and mortality after CABG.

5. Limitations

To begin small sample size of both groups stands as a big limitation in this study and more numbers are needed to draw a more firm conclusion. Nevertheless, our results still agree with most work done by other authors. Secondly, the results of this study may be affected by the fact that group B was by definition sicker than group A needing semiurgent operation leaving little room for preoperative strict diabetic control as compared to group A. Furthermore, we did not determine whether insulin-dependent patients had worse outcomes compared with those with diabetes controlled with diet or oral hypoglycemic medications, as has been done in other studies.[17] Thirdly, duration of diabetes milletus was not determined in each group and this is known to affect the outcomes.

6. Conclusions

This study showed that HbA1c is a good predictor of in-hospital morbidity. It worth devoting time and effort to decrease HbA1c level below 7% to decrease some of possible postoperative complications.

Conflict of interest

None declared.

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