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ORIGINAL RESEARCH

A study on preoperative HbA1c levels and their outcomes after cardiothoracic surgeries in a tertiary care hospital

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Abstract

Aim: An investigation on preoperative HbA1c levels and outcomes in patients after cardiothoracic surgeries in a tertiary care hospital.

Methods: This Retrospective, Comparative, and Analytical research was conducted in the field of cardiac patients with coronary artery disease, other valvular heart diseases, as well as those who had CABG under elective settings and whose haemoglobin (HbA1c) levels were noted, were included in this research. This research covered 200 patients. All patients were divided into two groups based on their preoperative HbA1c levels: Group 1 with HbA1c levels less than <7% and Group 2 with levels more than >7%. The patient's hospital stay and eventual result were recorded.

Results: In our research, 100 out of the 200 individuals had diabetes. In patients with HBA1c >7%, 77 percent had diabetes. 23 percent were having undiagnosed diabetics, and none were using any hypoglycemic medication. In terms of laboratory findings, there was a significant difference between Group 1 and Group 2 in each patient's fasting blood glucose (FBG) levels. The number of patients with severe LV dysfunction / reduced EF were substantially higher in group two as compared to group one (P value 0.03), as were the number of hypertensive, diabetic, and arrhythmic individuals.

Conclusion: Preoperative HbA1c level, in our view, is a robust predictor of morbidity following CABG, valvular and other cardiac surgeries. It has been advocated that in elective cases, these patients should be postponed for surgery till appropriate glycemic control is obtained. More prospective randomized long-term researches on the poor perioperative outcomes of diabetes in terms of preoperative HbA1c level are needed.

Keywords: HbA1c, cardiothoracic surgeries, CABG, diabetes.

Introduction

Diabetes mellitus is a clinical illness defined by hyperglycemia caused by an absolute or relative insulin insufficiency [1, 2] . Diabetes mellitus and its consequences are a huge danger to worldwide public health[1, 2]. Type 2 diabetes prevalence was 4.0 percent worldwide in 1995, and it is anticipated to climb to 5.4 percent by 2025, suggesting a 170 percent increase in the number of afflicted persons in emerging nations. It is anticipated that there would be around 228 million adult diabetics in developing nations by 2025[3]. Hyperglycemia is defined as an increased random plasma glucose level of more than 11.1mmol/L. Hyperglycemia is prevalent during the perioperative phase in both diabetic and non-diabetic patients having heart surgery, even when insulin is administered[4].

Hyperglycemia leads to increased urine production through osmotic diuresis, impairs wound healing, increases infection risk, and may compromise blood pressure management[5]. An rise

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in blood glucose level of 20 mg/dl was related with a more than 30% increase in unfavorable events[6]. In diabetic individuals, intraoperative hyperglycemia raises the risk of postoperative outcome after open heart surgery more than in non-diabetic patients[7]. Hyperglycemia in the early postoperative period remains an independent risk predictor of deep sternal wound infection and may be a causative component[8]. Diabetes mellitus has long been recognized as an independent risk factor for coronary artery disease development (CAD)[9]. The prevalence of CAD in people with type 2 diabetes varies from 13% to 43%.[9] and 20% to 30% of individuals having coronary artery bypass grafting surgery (CABG) had diabetes[10]. Type 2 diabetes is often asymptomatic in its early stages and may go unnoticed for years before being identified. Asymptomatic hyperglycemia has been linked to an increased risk of cardiovascular death, morbidity, and mortality following cardiac surgery in the undiagnosed diabetic population[11].

As a result, early identification, diagnosis, and treatment of type2 diabetes is critical for preventing diabetic complications and improving short and long-term outcomes in CABG and other cardiac surgery patients[12]. Fasting plasma glucose (FPG) and oral glucose tolerance tests are the most often utilized tests for diagnosing diabetes (OGTT). A number of studies have shown that up to 50% of diabetic individuals identified using OGTT criteria would have been overlooked using FPG criterion[13]. Despite being the diagnostic gold standard for diabetes, the OGTT is expensive, time consuming, and demanding, making it unsuitable for diabetes screening. As a result, a simple, cost-effective, efficient, and patient-friendly technology for diagnosing diabetes individuals would be extremely desired. Hemoglobin A1c is another indicated test for clinical diabetes screening (HbA1c)[14]. The HbA1c test evaluates average blood glucose levels over a three-month period. HbA1c is a quicker and simpler test that does not need fasting. According to revised evidence-based guidelines, an HbA1c level of 5.7 percent to 6.4 percent indicates pre diabetes, and an A1c level of 6.5 percent or higher indicates the presence of diabetes[15]. HbA1c is not only used for therapeutic monitoring or as an alternative test for screening, but it has also been reported to be useful in predicting both early and late outcomes after cardiac operations. A typical nondiabetic HbA1c ranges from 3.5 to 5.5 percent, and each 1% rise in HbA1c corresponds to a mean plasma glucose level increase of around 35 mg/dl (2 m mol/L)[16]. When compared to individuals with a HbA1c of less than 7%, HbA1c values more than or equal to 7% were related with a substantial increase in in-hospital mortality, renal failure, neurologic complications, and the composite index of infection[1]. Diabetes is projected to become more common in emerging nations. Patients receiving CABG surgery are at significant risk for diabetes. Most of these patients are unaware of their impaired glucose metabolism, owing to socioeconomic factors. This ignorance has a negative impact on the prognosis in the short and long term following surgery. HbA1c values for CABG and other cardiac surgeries patients may be beneficial for patients and should be included in standard preoperative workup[12].

Materials and methods

This Retrospective, Comparative, and Analytical research was conducted in our medical college on 200 patients of cardiothoracic surgeries. The data about patients, who needed surgical procedures was obtained from the patient records. Standard clinical examinations, regular biochemical and hematological tests, including previous Echocardiography and Angiography, were all included in all patients data. Diabetes mellitus was defined as a continuous plasma glucose level of 200 mg/dl, a fasting plasma glucose level of 126 mg/dl, a 2-hour plasma glucose level of 200 mg/dl in the 75 g oral glucose tolerance test, a HbA1c level of 6.5 percent, or treatment with oral hypoglycemic drugs or insulin injection. Patients with coronary artery disease, valvular heart diseases, as well as those who had CABG under elective settings and whose haemoglobin (HbA1c) levels noted preoperatively, were included

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in the research. Patients with the following conditions were excluded from the study: myocardial infarction three weeks before the operation, urgent surgery, cardiogenic shock, reoperation, left ventricular aneurysm reconstruction, renal failure and dialysis, male patients with hemoglobin levels less than 13 ml/dl, female patients with 12 mg/dl, and patients with unacceptable thyroid test results. This research covered 200 patients. All patients were divided into two groups based on their preoperative HbA1c levels: Group 1 with HbA1c level less than <7% and Group 2 with level more than >7%. Hospital stay and eventual results of patients were recorded. All patients had general anesthesia with intravenous induction of fentanyl, propofol, midazolam, and vecuronium. Before skin incision, all patients received an intravenous antifibrinolytic medication (tranexamic acid). All procedures were performed via a midline sternotomy incision. Intravenous heparin was used to prevent clotting. Intraoperative hyperglycemia was treated by continuous insulin infusion to keep the goal sugar level between 120 mg/dl and 180 mg/dl. Postoperative glycemic control was controlled using either continuous infusion or sliding scale subcutaneous boluses. Adverse occurrences during and after surgery were documented using hospital data. Arrhythmias, cerebrovascular accidents, haemorrhage, renal dysfunction, perioperative myocardial ischaemia, and other complications were observed. The demographic data, surgical risk, mortality, and morbidity of the two groups of patients were examined.

Results

Table 1 displays patients demographic and preoperative data. In terms of laboratory findings, there was a significant difference between Group 1 and Group 2 in each patient's fasting blood glucose (FBG) levels. The number of patients with severe LV dysfunction / reduced EF was substantially higher in group two compared to group one (P value 0.03), as were the number of hypertensive, diabetic, and arrhythmic individuals. Both groups had almost same types of cardiac surgeries though CABG with valvular heart surgery cases were more in group 2.

Table 1: Pre Operative Clinical parameter between the two groups

Clinical parameter	HbA1c < 7.0% (n=100) Group 1	HbA1c >7 % (n=100) Group 2	P value
Age	60±3.41 years	66 ±4.63 years	0.3
Male	71	65	0.17
Hypertension / Raised BP	31	69	0.03
EF (≤35)	3	17	0.027
Arrhythmias	13	23	0.03
Diabetes	23	77	0.001
AVR	8	6	
CABG + valve surgery	9	14	
DVR	11	5	
CABG	56	58	
MVR	16	17	

(CABG - Coronary artery bypass grafting, MVR - Mitral valve replacement, AVR-Aortic Valve Replacement, DVR – Double valve replacement, EF - Ejection fraction)

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Table 2 shows different intra-operative Variables affecting Outcomes between two groups. Group 2 patients needed more inotropes, IABP supports, blood transfusions during procedures. There were more arrhythmias in group 2.

Table 2: Per-operative outcomes between the two groups

Intra-operative Variables affecting Outcome	HbA1c < 7.0% (n=100) Group 1	HbA1c >7 % (n=100) Group 2	P value
Inotropes requirements more than two	39	43	0.43
IABP	5	7	0.63
Arrhythmias	33	71	0.2
ST Segment elevations (New)	7	5	0.55
Requirements of Transfusion	23	27	0.85

Table 3 showing outcomes after surgery in two groups. Major complications like need for dialysis, prolong IABP supports, stroke, severe infections, severe pneumonia, sterna wound infections, post operative drains, and deaths were more in group 2. Minor complications like superficial wound infections, pneumonias as well as ICU and hospital stay were more in patients having HbA1c>7%.

Table 3: Outcomes

Outcomes after surgery	HbA1c < 7.0% (n=100) Group 1	HbA1c >7 % (n=100) Group 2	Odds ratio
Major complications:			
Dialysis	3	6	2.06
IABP	5	7	1.43
Deaths	2	5	2.57
Arrhythmias	33	71	4.97
Stroke	2	3	1.51
Severe infections	1	3	3.06
Severe pneumonia	2	3	1.51
Sternal wound infection	1	3	3.06
Postoperative drain in ml/patient	345	570	
Other complications:			
Minor infections	3	5	1.70
Pneumonia	3	5	1.70
Superficial wound infections	2	4	2.02
Blood transfusions needed in patients	32	38	1.30
ICU stay in hours	37	53	
Length of Hospital stay	6.8 days	8.4 days	

Discussion

In our nation, the prognostic significance of haemoglobin A1c on short-term outcomes following coronary artery bypass graft surgery has not been studied. Haemoglobin A1c has been shown to be beneficial in predicting both early and late outcomes after CABG and other cardiothoracic surgeries. Diabetes has become a serious public health concern, contributing to morbidity and death from coronary artery disease and valvular heart diseases. Many people have poor glycemic control, despite lifestyle modifications and drugs that have been demonstrated to reduce complications and mortality. In this research, we looked back at data from 200 individuals who had elective heart surgery. Adverse occurrences during and after

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surgery were documented using hospital data. Arrhythmias, cerebrovascular accidents, haemorrhage, renal dysfunction, perioperative myocardial ischaemia, and other complications were observed. The demographic data, surgical risk, mortality, and morbidity of the two groups of patients were examined. Poor glycemic control (baseline HbA1c) prior to ischemic stroke is an independent risk factor for poor survival and a signal for increased stroke severity and adverse long-term functional outcome, according to a new research of 501 patients[17]. In our research, 100 of the 200 individuals had diabetes. In patients with HBA1c >7%, 77 percent had diabetes. 23 percent were undiagnosed diabetics, and none were using any hypoglycemic medication. Many studies comparing diabetic and non-diabetic individuals following coronary revascularization surgery produced contradictory findings. In their investigation, Calafiore and colleagues demonstrated that diabetes mellitus was an independent risk factor for early cardiac mortality and morbidity[18,19]. Rajakaruna et al discovered that diabetes and non-diabetic individuals had equal death results[18]. According to a study conducted by Kubal et al, diabetic patients who were on insulin had more postoperative problems than patients who had just a history of diabetes[20]. Carson and colleagues compared outcomes in 41,663 diabetes patients to 1,05,123 non-diabetic individuals and found a nearly 30% increase in total problems rate in diabetic patients when compared to non-diabetic patients[21]. Furnary and colleagues showed that perioperative glycemic management with continuous insulin infusion lowered death and infection rates in diabetic patients[22,23]. Even after controlling for mean glucose levels on the day of surgery and the first three postoperative days, preoperative HbA1c level remained an independent predictor of death and wound infection following CABG in the multivariate analysis[24]. In our investigations, the number of patients with severe LV dysfunction / reduced EF was substantially higher in group two compared to group one (P value 0.027), as were the numbers of hypertensive, diabetic, and arrhythmic patients in preoperative clinical variables, significant in-hospital variables influencing the outcome were renal failure necessitating dialysis, surgical site infection, prolonged ventilation duration, cardiac events, and reintubation. Knapik et al[25] published a retrospective study of 782 diabetic individuals to compare results, patients were matched using a Greedy matching technique to obtain identical preoperative condition. When compared to the HbA1c, higher HbA1c values >7% were substantially related with an increased risk of perioperative myocardial infarction (MI) in matched individuals. Alserius et al[26] performed a prospective analysis in 605 individuals to correlate HbA1c concentrations with infection rates and death outcomes. In patients with HbA1c ≥6%, the rate of superficial sternal wound infection was considerably higher (13.9 percent HbA1c 6% versus 5.2 percent when HbA1c. In this study, researchers discovered a link between HbA1c levels and the development of infection in patients after coronary artery bypass surgery. Diabetes has been identified in certain studies as a risk factor for poor operational mortality after CABG[20]. Similar to our results, no significant link between diabetes and mortality was reported in other research[27,28]. It seems probable from these results that HbA1c is also an independent predictor of postoperative adverse outcomes that is not completely related to intra and postoperative glucose management. In these individuals, more aggressive glucose control should be employed throughout the perioperative phase. The American Diabetes Association now recommends HbA1c test of diabetic patients every three months in patients with increased HbA1c readings (>7%) or in individuals requiring medication changes to ensure an optimal treatment plan[29].

Conclusion

Preoperative HbA1c levels, in our view, are a robust predictor of morbidity following CABG and other valvular heart surgeries. It has been advocated that in elective cases, these patients to be postponed for surgery till appropriate glycemic control is obtained. More prospective

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randomised long-term research on the poor perioperative outcomes of diabetes in terms of preoperative HbA1c levels are needed.

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