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Original Article

Age versus HBA1c: Which is a better predictor of Acute Kidney Injury in Diabetics after CABG?

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ABSTRACT

Diabetes is a proven risk factor for the development of Acute Kidney Injury after CABG. Other multiple factors that are involved in causing AKI after CABG like pre-operative renal dysfunction, long CPB time, and low cardiac output syndrome. We controlled all the variables, to study the difference between age and HBA1c levels in predicting acute kidney injury after CABG. **Objective:** The purpose of the study is to take the diabetic population and control other variables involved in the causation of AKI after CABG and study the role of age versus HBA1c levels in predicting AKI after elective CABG. **Methods:** A total of 200 diabetic patients who underwent elective CABG were selected from May 2021 to May 2022 at NICVD Karachi. The KDIGO criteria for AKI was applied. **Results:** The incidence of AKI in our study was 36.5%. 52.7% patients developed AKI with HBA1c of 6.5 – 7.4%; 40% developed AKI with HBA1c levels of 7.5 – 8.4%, 16% AKI with HBA1c of 8.5 to 8.9%, 12% AKI in patients with HBA1c of 9 – 9.4%, 18% AKI with HBA1c of 9.5 – 9.9%, 20% for HBA1c of 10.01 – 10.04% and 83.3% for HBA1c > 10.04%. There was a 4.35% frequency of AKI for ages between 40 – 49 years; 26.8% frequency for ages between 50 – 59 years; 50.7% AKI for 60 -69 years and 84% for the population between 70 to 80 years. **Conclusions:** Increasing age is a better predictor of acute kidney injury following CABG than increasing HBA1c levels till the HBA1c level of 10.04% after which it becomes equivalent to the risk as present in diabetics above 70 years old.

INTRODUCTION

Acute kidney injury (AKI) is a common complication after cardiac surgery occurring in about 30 % of patients [1]. Diabetes Mellitus possess an increased risk of AKI after CABG. AKI not only impairs kidney function but also puts a strain on the function of lungs, brain, and gut and adds a 5-fold increase in the risk of death with AKI [2]. Acute coronary syndrome is one of the dominant causes of AKI [3]. Renal ischemia, hemolysis, inflammation, hemolysis, cholesterol emboli, toxins, and oxidative stress contribute to the causation and progression of AKI. Preventive strategies are currently limited, but evidence supports the maintenance of adequate renal perfusion by raising the mean pressures on CPB, intravascular volume resuscitation, and maintenance of postoperative renal perfusion by maintaining mean pressures and avoidance of nephrotoxic drugs [4]. AKI requiring renal replacement therapy has a frequency of about 2–5 % and is associated with a mortality of 50% [5,6,7]. Diabetes Mellitus is associated with an increased risk of AKI [8,9]. A higher HBA1c level is a better predictor of postoperative outcomes like reintubation, post-operative wound infection, and bleeding [10]. The incidence of AKI was found to be 13% higher in patients with HBA1c levels of > 5.6% [11]. Age plays a major role in causing acute kidney injury after open heart surgery. It has been regarded as an independent risk factor in predicting acute kidney injury after cardiac surgery [12]. CABG is defined as "coronary artery bypass graft surgery". The operation is done to bypass a blocked coronary artery

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to alleviate the symptoms caused by a blocked artery like chest pain and shortness of breath. It is one of the common operations performed in cardiac surgery units with a mortality of less than 1 % [13]. The purpose of the study is to take the diabetic population and control other variables involved in the causation of AKI after CABG and study the role of age versus HBA1c levels in predicting AKI after elective CABG.

METHODS

A sample of 200 patients was taken from the cardiac surgery department. All diabetics were selected based on the standard definition of diabetes [14]. Age was confirmed from the computerized national identity cards. Only male population was selected as there was more age discrepancy issues with the female gender in our region. The KDIGO criteria for acute kidney injury was applied for the diagnosis [15]. Study inclusion criteria: Diabetics (having more than one month since diagnosis of diabetes) undergoing CABG, age 40 to 80 years, male gender, patients on oral anti-hyperglycemic or insulin/ controlled or uncontrolled blood sugar levels, patients undergoing elective CABG and type 2 diabetics. Our exclusion criteria included deranged pre-operative renal function with a serum creatinine level of > 1.2 mg/dl, diagnosed renal failure patients, patients on dialysis before operation, patients who have received renal transplantation (recipients), patients undergoing valvular surgeries, patients undergoing emergency CABG, patients suffering from other endocrine disorders along with diabetes, type 1 diabetic, LVEF < 40%; preoperative, per-operative or post-operative usage of IABP, long pump runs of more than 4 hours, CABG with concomitant valvular operation; and those who refuse to cooperate in the questionnaire or not willing to participate in my research and those left without medical advice. Informed verbal consent for participation was taken from all our patients in the study. HBA1c levels and renal function status was noted before CABG. The recent laboratory values for HBA1c levels and serum creatinine which were less than 7 days old were only considered. Post-operative renal function tests and urine output was measured according to the KDIGO criteria. Patients having post-operative low cardiac output syndrome or long pump runs were then excluded from our sample. All the sample is taken from the cardiac surgery department of our institute. All the operations were performed by senior cardiac surgeons having more than 5 years of post-fellowship experience in the field. Patient confidentiality was strictly maintained. The total study duration was 1 year from May 2021 to May 2022. The data was collected and analyzed via SPSS version 23 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Frequency calculated by standard methods. Mean ± standard deviation was obtained for quantitative variables like age (years), height (cm), weight (kg), and body mass index (kg/m2). Frequencies and percentages were calculated for categorical variables like gender and comorbidities. A non-parametric chi-square test is applied to the data. Statistical significance is kept at p<-0.05. Data is presented in graphical form through bar charts.

RESULTS

The data from 200 diabetic patients was analyzed to produce the results. The mean age was 55.9 ± 8.0 years and BMI was 26.4 ± 4.3 kg/m2. Our sample consisted of only the male population. Only patients with an LVEF > 40% were included in the study. There were 34% of patients with an LVEF of 40 – 50% and 66% of patients with an LVEF of 50% as shown in Figure 1. All patients with moderate to severe LVEF dysfunction were excluded from our sample to minimize the effect of reduced LV function on kidney function. All patients with pre-operative normal kidney functioning were included in the study. The KDIGO criteria for acute kidney injury was applied to detect AKI. A total of 73 (36.5%) patients developed AKI. All the data was stratified into smaller sets to increase the accuracy level to find the variable which was playing a dominant role in causing AKI in post-CABG patients. There was a 4.35% frequency of AKI in ages between 40 – 49 years; 26.8% for ages between 50 – 59 years; 50.7% AKI for 60 -69 years set and 84% for the population between 70 to 80 years as shown in Table 1 and figure 1.

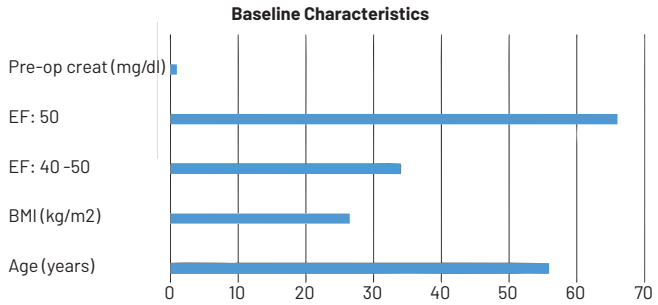

Figure 1: Baseline Characteristics

AGE (years)	NUMBER OF PATIENTS	AKI	PERCENTAGE OF AKI
40 -49	46	2	4. 35%
50- 59	66	18	26. 8%
60- 69	63	32	50. 7%
70- 80	25	21	84 %
TOTAL	200	73	

Table 1: Percentage of AKI

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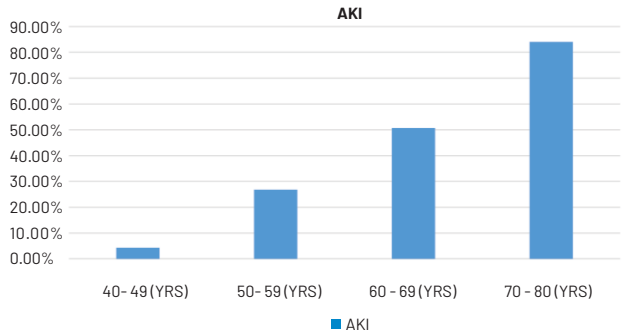

Figure2: Age in Percentage

A similar stratification was applied for HBA1c levels. The values for HBA1c were divided into short sets and % of AKI for each set was calculated. 52.7% of patients developed AKI with HBA1c of 6.5 – 7.4%; 40% AKI with HBA1c levels of 7.5 – 8.4%, 16% AKI with HBA1c of 8.5 to 8.9%, 12% AKI in patients with HBA1c of 9 – 9.4%, 18% AKI with HBA1c of 9.5 – 9.9%, 20% for HBA1c of 18% and 20% for HBA1c > 10.04% as shown in Table 2 and figure 2.

HBA1c (%)	NUMBER OF PATIENTS	AKI (%)
6.5 7.4	55	29(52.7%)
7.5 – 8.4	35	14 (40%)
8.5 – 8.9	25	4 (16%)
9 – 9.4	25	3(12%)
9.5 – 9.9	22	4 (18%)
10.01 – 10. 04	20	4(20%)
Above 10.04	18	15 (83.3%)

Table 2: Stratification for HBA1c

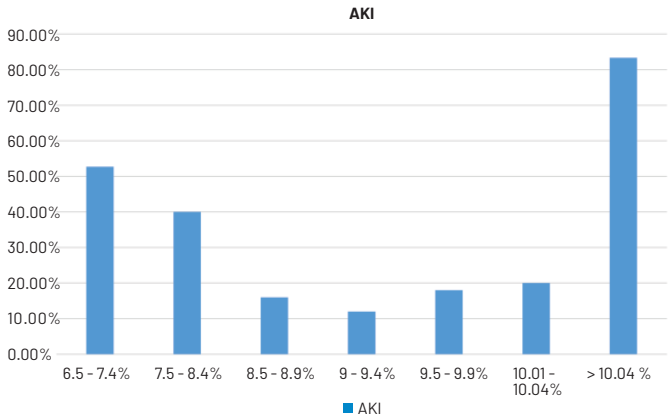

Figure 3: Percentage of HBA1c with AKI patients

After these results, we made one of our one variable constant to check for significance levels. All patients of age 60 were selected, there were a total of 18 patients aged 60. 15 patients developed AKI and their HBA1c levels were divided into short groups. The Chi-square test was applied to find the significance level as shown in Table 3.

HBA1c	AKI (%)	p-value
6.5 -7.4 (6)	5(83%)	0.7
7.5 – 8.4 (5)	3(60%)	
8.5 – 10.0 4 (4)	3(75%)	
>10.04 (3)	3(100%)	

Table 3: Significance level

After this, we made our HBA1c levels constant at 7% and divided our patient's ages into different sets. There were 25 diabetics with an HBA1c level of 7% and 16 patients developed AKI. Chi-square test was applied to find the significance level as shown in Table 4. Thus, the data concludes that increasing age is a better predictor of AKI after CABG than increasing HBA1c levels. (p = 0.02).

Age (years)	AKI (%)	p-value
40 -49 (5)	1(1%)	0.02
50- 59 (8)	5 (2.8%)	
60- 69 (7)	5 (3%)	
70- 80 (5)	5 (5%)	

Table 4: Significance level

DISCUSSION

Acute Kidney injury is a common complication after CABG [16]. Our majority population consists of diabetics [17]. Our common approach is to assess the HBA1c levels and if the HBA1c levels are lower, we ignore the risks of AKI. This study serves the purpose to invalidate the belief that lower HBA1c cannot cause AKI. According to this study, any patient of age 65 years with a low HBA1c will have almost a 50% risk of developing AKI. This study will change our perspective on how we see the risk population of AKI. Once the high-risk patients are identified, it is easy to control the per-operative and post-operative factors to prevent renal impairment [18]. Cevedet et al., analyzed the role of HBA1c levels in non-diabetics to find the incidence of AKI. Their cut-off value for HBA1c was 5.6%. It was concluded that there was a 13% increased incidence of AKI when HBA1c was more than 5.6% [19]. H Palomba et al., developed the prediction model for "Acute Kidney Injury After Cardiac Surgery (AKICS) score". The incidence of AKI predicted was 55% with age > 65 years and 35% incidence in diabetics [20]. If we compare our study with this prediction model, we have controlled all other factors i-e only CABG patients were selected with pre-operative serum creatinine < 1.2 mg/dl. Low cardiac output syndrome and use of IABP were excluded. Our incidence of AKI after CABG in population between 60 to 69 years was 50.7% which closely correlates with the Brazilian study Our incidence of AKI in diabetics was 36.5 % [21]. Joud et al., studied the difference in length of stay between patients with a cut-off HBA1c level of 7.0% and found no difference in length of hospital stay between diabetic patients who had HBA1c of less than 7% and those

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with more than 7% [22]. Our study has already negated the role of levels of HBA1c in predicting AKI till 10. 04%. So, we can say that there will be no difference in length of stay. Yang Zu et al., performed a study on a Swedish Cohort. They studied the relationship between HBA1c levels and the incidence of AKI. They divided their cohort into 5 levels. HBA1c of less than 6%, 6 – 6.9%, 7 – 7.9%, 8 – 8.9% and ≥ 9 %. They found that HBA1C 9% was associated with a higher risk of AKI. 10. Age > 70 years has been quoted as an independent risk factor for AKI. Not only this, a meta-analysis further concluded that aged individuals have a poor recovery of renal function after AKI [23]. A research was performed by Gur K and co on 118 diabetic patients who underwent CABG. They divided their diabetics into HBA1c <7% and more than 7%. They concluded that Hemodialysis may be required after CABG in diabetics however, there was no relationship between post-operative hemodialysis and pre-operative HBA1c levels [24]. The literature review has helped in better understanding the variables in our subject. Our study has clarified the comparative difference between age and HBA1c levels in predicting acute kidney injury in diabetics after CABG.

CONCLUSIONS

Increasing age is a higher risk factor in diabetics even in the presence of lower HBA1c levels. On the other contrary, younger patients had a lower risk of AKI despite high HBA1c levels. Increasing age dominates in predicting acute kidney injury after CABG in diabetics. However, after a certain limit of HBA1c of more than 10.04%, this difference diminishes and the ratio of AKI becomes equivalent to the risk as present in above 70 years diabetic population.

Conflicts of Interest

The authors declare no conflict of interest.

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