`Research Paper

Admission Glycemic Status in Diabetic Patients with Acute Coronary Syndrome

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ABSTRACT:

BACKGROUND:

Cardiovascular complications are more common among diabetic patients and are usually associated with a significantly greater risk of morbidity and mortality than in nondiabetic subjects. Hyperglycemia during stress situations, especially during Acute Coronary Syndrome, may also be seen in nondiabetic patients. Regardless of diabetes status, hyperglycemia on arrival for patients presenting with Acute Coronary Syndrome has been associated with adverse outcomes, including death.

OBJECTIVE:

To study the state of serum glucose concentration at hospital admission in diabetic patients with acute coronary syndromes.

METHODS:

A cross sectional study that conducted at Al-Kindy Teaching Hospital for a period of twelve months from the 1st of Mar. 2021 till the 1st of March 2022. It included 100 patients who were admitted to the Coronary Care Unit and diagnosed with Acute Coronary Syndrome. Admission plasma glucose concentrations from blood samples drawn on arrival in the emergency room were recorded.

RESULTS:

In this study, 53% of patients had admission acute phase hyperglycemia. the highest proportion of study patients who did not smoke was diabetic (60.9%) with a significant association between study group and smoking status. We noticed that 76.5% of patients with STEMI were diagnosed with admission acute phase hyperglycemia with a significant association between acute phase hyperglycemia and Acute Coronary Syndrome symptom.

CONCLUSION:

Newly-diagnosed hyperglycemia is obviously a common metabolic problem among patients with acute coronary syndrome. Hyperglycemia is a major problem in our patients with and without past history of diabetes when they are presented with Acute Coronary Syndrome.

KEYWORDS: Acute Coronary Syndrome, ST elevation, hyperglycemia, diabetes, Iraq.

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INTRODUCTION:

Acute Coronary Syndrome (ACS), a type of cardiovascular ailment, was responsible for 17.9 million fatalities in 2018, representing approximately 23% of global deaths[1,2]. Previous studies have highlighted a significant contrast in the mortality rates attributed to cardiovascular diseases (CVDs) between high-income countries and low and middle-income countries (LMICs)[2]. ACS encompasses three primary categories: Evolving Myocardial Infarction (MI), which is typically classified into ST-segment elevation MI (STEMI), MI without ST-segment elevation (NSTEMI), unstable angina(UA) and new-onset Left Bundle Branch Block (LBBB)[1].

As individuals age, the incidence of ischemic heart disease (IHD) in general, including Acute Coronary Syndrome (ACS), rises with men, typically experiencing this increase 7–10 years earlier than women. Below the age of 60, ACS is more prevalent in men, but women constitute the majority of patients over 75 years old. Significant variations exist in the incidence, prevalence, and case fatality rates of IHD and ACS across different regions worldwide[3]. ACS typically occurs in individuals with atherosclerosis. The primary lesion triggering the acute event is often a complex, ulcerated or fissured atheromatous plaque with a thrombus rich in platelets adhering to it, along with localized coronary artery spasm. These vascular changes during an acute coronary syndrome are dynamic, with the degree of obstruction potentially increasing, leading to complete vessel occlusion, or regressing due to platelet disaggregation and endogenous fibrinolysis. In cases of acute Myocardial Infarction (MI), the occlusive thrombus is typically found at the site of rupture or erosion of an atheromatous plaque[(4)].

ACS diagnosis should be considered in all patients presenting with symptoms of ischemic events, which can manifest as retrosternal chest pain, upper extremity discomfort, mandibular or epigastric discomfort, shortness of breath, diaphoresis, nausea, fatigue, or syncope[(5)]. The pain and discomfort associated with an ACS event could occur with exertion or at rest and are typically diffuse rather than localized. Chest Pain radiating to the left arm, right shoulder, or both arms, along with pain associated with diaphoresis, are more likely to be associated with MI[(6)]. However, these symptoms are not specific to MI and may not occur in all patients experiencing an ACS event. Some patients present with atypical symptoms of ACS such as the elderly, diabetics, women or postoperatively, where ACS may present with cardiac arrest, palpitations, or an asymptomatic clinical presentation[(5)].

Diabetes has emerged as a significant contributor to mortality and morbidity worldwide, with an estimated 422 million people affected, particularly in middle and low-income countries[(6)]. By 2030, diabetes is projected to become the seventh leading cause of death globally. Cardiovascular complications are more prevalent among diabetic patients, posing a substantially higher risk of morbidity and mortality compared to nondiabetic individuals[7]. Diabetic men have a 50% greater relative risk of MI, while diabetic women phase 150% greater risk compared to age-matched non-diabetic counterparts. Sudden cardiac death is also more frequent in diabetic individuals, with a 50% higher incidence in men and a 300% higher incidence in women compared to age-matched non-diabetic controls. Studies have shown a higher incidence of ACS and significantly increased ACS mortality rates in both male and female diabetic populations, with a linear positive relationship between admission hyperglycemia and mortality after ACS[(8,9)].

Hyperglycemia on admission to the hospital is common in patients with ACS and is associated with increased in-hospital complications and mortality rates (10-11). The prevalence of admission hyperglycemia ranges from 51% to over 58% of ACS patients, with up to 20% of acute MI patients without known diabetes experiencing hyperglycemia during hospitalization[(12,13)]. Hyperglycemia is linked to higher in-hospital, 30-day, and 1-year mortality rates, even exceeding those of patients with hyperglycemic AMI and known diabetes[(14,15)]. The exact mechanisms underlying this association are not fully understood, but potential contributors could be underlying but unrecognized diabetes[(16,17)].

OBJECTIVE OF STUDY:

To study the state of serum glucose concentration at hospital admission in diabetic patients with acute coronary syndromes.

PATIENTS AND METHODS:

The study was a cross-sectional study conducted in the Department of Internal Medicine at Al-Kindy Teaching Hospital over a twelve-month period from the 1st of March 2021 to the 1st of March 2022. It involved 100 patients admitted to the Coronary Care Unit (CCU) diagnosed with Acute Coronary Syndrome (ACS), including unstable angina (UA) and myocardial infarction (MI), both types ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation myocardial infarction (NSTEMI), in addition to cases of new left bundle branch block (LBBB). Patients were required to have at least one documented blood glucose measurement at the time of admission. Diagnosis of STEMI was based on symptoms, electrocardiogram findings, and biochemical markers of myocardial necrosis.

The criteria for diagnosing STEMI included any two of the following[18]:

1. Cardiac chest pain lasting at least 30 minutes.
2. ST elevation of more than 0.1 mV in at least one standard lead.
3. ST elevation of more than 0.2 mV in two or more contiguous chest leads.
4. Presence of new LBBB along with biochemical markers of myocardial injury.

Unstable angina was defined by at least one of the following (19):

1. Worsening of a previously stable pattern of angina or chest pain at rest.
2. Minimal exertion with transient ST-segment elevation or depression on electrocardiogram.
3. Elevation of biochemical markers of myocardial injury not meeting the criteria for

MI (cardiac troponin I [cTnI] levels between 0.1 and 1.49 ng/ml).

Clinical symptoms of ACS (including STEMI, NSTEMI, unstable angina, and new LBBB) and admission plasma glucose concentrations were recorded. Acute phase hyperglycemia was defined as a non-fasting glucose level equal to or above 140 mg/dl regardless of past history of diabetes (20). Newly detected diabetes was defined as hyperglycemia with fasting plasma glucose levels ≥ 126 mg/dl or postprandial glucose levels ≥ 200 mg/dl.

Patients were categorized into three groups based on their history of diabetes and plasma glucose levels on admission:

1. Diabetic group: 46 patients with a history of diabetes mellitus (DM).
2. Normoglycemia group: 30 nondiabetic patients with random blood sugar (RBS) < 140 mg/dl.
3. Acute phase hyperglycemia group: 24 nondiabetic patients with RBS ≥ 140 mg/dl.

Electrocardiograms were performed for all study patients, and echocardiography was conducted within 24 hours of admission using vivid EQ equipment. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25, with mean, standard deviation, and ranges presented for continuous variables and frequencies and percentages for categorical data. The association between study groups and certain information was assessed using the chi-square test, with a P-value less than 0.05 considered significant.

RESULTS:

The study included a total of 100 patients, all diagnosed with acute coronary syndrome. The distribution of patients by general characteristics is illustrated in figures 1 and 2 and summarized in table 1. The age of the study patients ranged from 33 to 95 years, with a mean age of 60.79 years and a standard deviation (SD) of ± 11.42 years. The highest proportion of patients fell within the age group of 60 to 69 years, accounting for 42% of the total.

In terms of gender distribution, males outnumbered females, comprising 61% of the study population compared to 39% for females. This yielded a male-to-female ratio of 1.56:1.

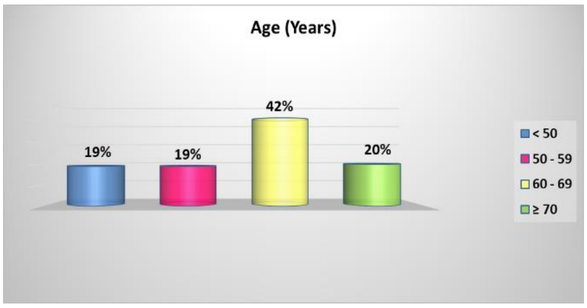

Figure 1: The Distribution of study patients by age.

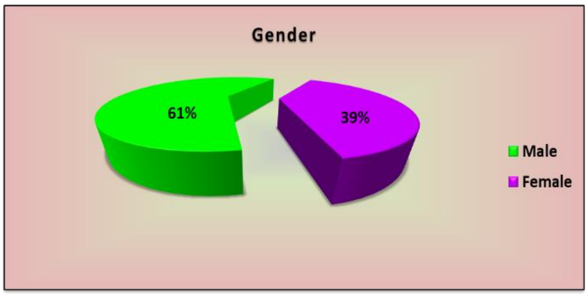

Figure 2: The Distribution of study patients by gender.

Table 1: The Distribution of study patients by clinical symptoms of ACS.

Clinical symptom of ACS	No. (n= 00)	Percentage (%)
ST-segment elevation MI	51	51.0
Non-ST-segment elevation MI	18	18.0
Unstable Angina	31	31.0

The distribution of study patients by prevalence of admission acute phase hyperglycemia is shown in table 2. Study patient's RBS at admission was ranging from 70 to 550 mg/dl with a mean of 187.42 mg/dl and SD of ± 117.72 mg/dl; and 53% of patients had admission acute phase hyperglycemia.

Table 2: The Distribution of study patients by prevalence of admission acute phase hyperglycemia.

Acute phase hyperglycemia	No. (n= 100)	Percentage (%)
Yes (RBS ≥ 140 mg/dl)	53	53.0
No (RBS < 140 mg/dl)	47	47.0

The distribution of study patients by comorbidity is shown in table 3. In this study, 46% of patients were diabetics, 54% were hypertensive, and 58% of them had a history of ischemic heart disease.

Table 3: The Distribution of study patients by comorbidity.

Variable	No. (n= 100)	Percentage (%)
Diabetes mellitus		
Yes	46	46.0
No	54	54.0
Hypertension		
Hypertension	46	46.0
No	54	54.0
Ischemic Heart Disease		
Yes	42	42.0
No	58	58.0

For analytical purposes, the study patients were categorized into three groups based on their history of diabetes and plasma glucose levels on admission, as depicted in figure 3:

Diabetic group: This group consisted of 46 patients with a documented history of diabetes mellitus (DM).

Normoglycemia group: Comprising 30 patients, this group included individuals without a history of diabetes and with random blood sugar (RBS) levels below 140 mg/dl on admission.

Acute phase hyperglycemia group: Consisting of 24 patients. This group comprised individuals without a history of diabetes but with RBS levels equal to or exceeding 140 mg/dl on admission.

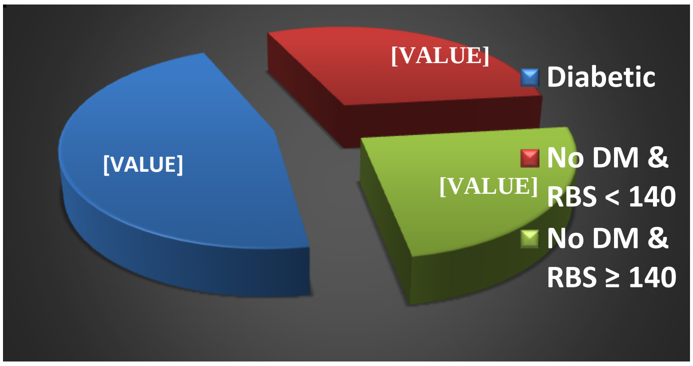

Figure3: The Distribution of study patients by history of diabetes and their plasma glucose levels on admission.

Table 4 shows the association Characteristics in patients with normoglycemia, acute phase hyperglycemia, and diabetes. In this study, the highest proportion of study patients who didn't smoke was diabetic (60.9%) with a significant association between study group and smoking status (P= 0.001).

There were no significant associations (P ≥ 0.05) between study group and all other characteristics.

Table 4: The Association between study group and general characteristics.

Variable	Study group: Diabetic (%) n= 46	Study group: Normoglycemia (%) n= 30	Study group: Acute phase hyperglycemia (%) n= 24	Total (%) n= 100	P - Value
Age (Year)					
< 50	9 (47.4)	5 (26.3)	5 (26.3)	19 (19.0)	**0.687**
50 - 59	7 (36.8)	8 (42.1)	4 (21.1)	19 (19.0)	
60 - 69	22 (52.4)	9 (21.4)	11 (26.2)	42 (42.0)	
≥ 70	8 (40.0)	8 (40.0)	4 (20.0)	20 (20.0)	
Gender					
Male	27 (44.3)	17 (27.9)	17 (27.9)	61 (61.0)	**0.518**
Female	19 (48.7)	13 (33.4)	7 (17.9)	39 (39.0)	
Smoking Status					
Yes	7 (19.4)	15 (41.7)	14 (38.9)	36 (36.0)	**0.001**
No	39 (60.9)	15 (23.4)	10 (15.6)	64 (64.0)	

Table 5 shows the association between study group and ACS symptoms. In this study, the highest proportion of study patients who had unstable angina were normoglycemic (51.6%) with a significant association between study group and ACS symptom (P= 0.001).

Table 5: The Association between Study group and ACS symptoms.

ACS Symptom	Study group: Diabetic (%) n= 46	Study group: Normoglycemia (%) n= 30	Study group: Acute phase hyperglycemia (%) n= 24	Total (%) n= 100	P - Value
Stemi	25 (49.0)	8 (15.7)	18 (35.3)	51 (51.0)	**0.001**
Non-Stemi	6 (33.3)	6 (33.3)	6 (33.3)	18 (18.0)	
Unstable angina	15 (48.4)	16 (51.6)	0 (0)	31 (31.0)	

Table 6 shows the association between study group and admission acute phase hyperglycemia. In this study, 54.7% of study patients were diabetic with a significant association between study group and admission acute phase hyperglycemia (P= 0.001).

Table 6: The Association between study group and admission acute phase hyperglycemia.

Acute Phase Hyperglycemia	Study group: Diabetic (%) n= 46	Study group: Normoglycemia (%) n= 30	Study group: Acute phase hyperglycemia (%) n= 24	Total (%) n= 100	P - Value
Yes	29 (54.7)	0 (0)	24 (24.0)	53 (53.0)	**0.001**
No	17 (36.2)	30 (63.8)	0 (0)	47 (47.0)	

Table 7 shows the association between admission acute phase hyperglycemia and ACS symptom. We noticed that 76.5% of patients with STEMI were diagnosed with admission acute phase hyperglycemia with a significant association between acute phase hyperglycemia and ACS symptom (P= 0.001).

Table7: The Association between admission acute phase hyperglycemia and ACS symptom.

ACS	Admission Acute Phase Hyperglycemia Yes (%) n= 53	No (%) n= 47	Total (%) n= 100	P - Value
STEMI	39 (76.5)	12 (23.5)	51 (51.0)	**0.001**
Non-STEMI	8 (44.4)	10 (55.6)	18 (18.0)	
Unstable Angina	6 (19.4)	25 (80.6)	31 (31.0)	

Table 8 shows the association between admission acute phase hyperglycemia and comorbidity. No significant associations (P ≥ 0.05) between admission acute phase hyperglycemia and comorbidity.

Table 8: The Association between admission acute phase hyperglycemia and comorbidity.

Variable	Admission Acute Phase Hyperglycemia Yes (%) n= 53	No (%) n= 47	Total (%) n= 100	P - Value
Hypertension				
Yes	25 (54.3)	21 (45.7)	46 (46.0)	**0.803**
No	28 (51.9)	26 (48.1)	54 (54.0)	
Diabetes mellitus				
Yes	26 (61.9)	16 (38.1)	42 (42.0)	**0.129**
No	27 (46.6)	31 (53.4)	58 (58.0)	

DISCUSSION:

In this investigation, the majority of patients presented with ST-segment elevation myocardial infarction (STEMI), accounting for 51% of the study population. This finding aligns with previous studies by Benamer et al. (2015)[(21)], Correia et al. (2009)[22], and Wilby et al. (2016)[(23)], which reported varying proportions of acute myocardial infarction (AMI) and unstable angina among patients with diabetes and acute coronary syndrome (ACS). Benamer et al. found that over half of diabetic patients admitted with ACS had AMI, while Wilby et al. observed a high prevalence of STEMI among their study patients. Conversely, Correia et al. reported a relatively balanced distribution between unstable angina and non-ST elevation AMI among their study subjects.

In our study, 53% of patients exhibited admission acute phase hyperglycemia, which differs from the lower prevalence rates reported by Mansour et al. (2011) [11] and Modenesi et al. (2012)[23] in their investigations of acute phase hyperglycemia among patients with ACS. Furthermore, we observed a significant association between normoglycemic patients and unstable angina, consistent with findings by Karetnikova et al. (2016)[(24)], who reported a higher prevalence of angina pectoris and congestive heart failure among patients with diabetes compared to those without.

Additionally, we found a significant association between diabetes and admission acute phase hyperglycemia, corroborating the findings of Modenesi et al. (2012)[(23)] and Mansour et al. (2011)[(11)], who also observed elevated blood glucose levels among diabetic patients with ACS. However, no significant associations were found between admission acute phase hyperglycemia and age, gender, or smoking status, a result consistent with previous studies by Modenesi et al. (2012)[(23)] and Mansour et al. (2011)[(11)].

Furthermore, our study revealed a significant association between admission acute phase hyperglycemia and STEMI, in contrast to the findings of Modenesi et al. (2012)[(23)], who found no relationship between stress hyperglycemic status and ACS components. Similarly, Mansour et al. (2011)[(11)] reported no significant associations between acute phase hyperglycemia and ACS components, although they did observe a significant association between hyperglycemia and hypertension.

Diabetes mellitus is established risk factor for coronary artery disease (CAD), with poor glycemic control contributing to endothelial injury and the development of CAD and AMI. Hyperglycemia is frequently observed in patients with AMI, regardless of diabetic status, as demonstrated by epidemiological studies such as that conducted by Mansour et al. (2011)[(11)].

In terms of demographic characteristics, our study found a male predominance, consistent with the findings of Pintó et al. (2010)[(25)], who reported a male-to-female ratio of 3.9:1 among patients admitted to coronary care units. However, Thabet et al. (2015)[26] reported a more balanced gender distribution among their study subjects, with a male-to-female ratio of 1.4:1. These variations in gender distribution highlight the differences in patient populations across different studies.

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