ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 09, 2024

Original Research Article

A study of random blood glucose and its correlation with HbA1c level in COVID-19-positive patients

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Abstract

Background: There has already been much evidence linking diabetes to public health threats globally, and the disease has been established to pose an increased risk of severe actions in COVID-19 cases. **Objective:** The basic aim of this study is to find random blood glucose and its correlation with HbA1c levels in COVID-19-positive patients. **Methodology:** This cross-sectional study was conducted at Department of Medicine, Venkateshwara Institute of Medical Sciences Gajraula U.P. India during 1st July 2020 to 31 Dec 2022. The study included 185 patients who met the inclusion criteria of the study.Data were collected through systematically designed questionnaires which included all information related to demographics, gender, history, and

symptoms of disease. Upon admission, random blood glucose levels were measured using a glucometer.**Results:** Data were collected from 185 patients with a mean age of 58.4±12.3 years and a mean BMI of 28.6±4.5 kg/m². Males constituted 59.5% (n=110) of the sample, while females made up 40.5% (n=75). The mean random blood glucose (RBG) level was 194.3±68.5 mg/dL, and the mean HbA1c was 7.8±1.5%, indicating a notable degree of acute and chronic hyperglycemia among the patients.In the overall patient group (n=185), the correlation coefficient was 0.63 ($p < 0.001$), indicating a moderate correlation. In diabetic patients (n=85), the correlation was stronger, with an r-value of 0.71 ($p < 0.001$). Among non-diabetic patients (n=100), the correlation was weaker but still significant, with an r-value of 0.52 ($p < 0.01$).**Conclusion:** It is concluded that both random blood glucose (RBG) and HbA1c levels are important markers in predicting the severity and outcomes of COVID-19 in infected patients, particularly those with pre-existing diabetes.

Keywords: COVID-19, Patients, Diabetic, Outcomes, HbA1c

Introduction

The emergence of the COVID-19 pandemic has dramatically altered the landscape of global healthcare, not only by the direct morbidity and mortality caused by the SARS-CoV-2 virus but also by its profound effects on various comorbid conditions, including diabetes mellitus. There has already been much evidence linking diabetes to public health threats globally, and the disease has been established to pose an increased risk of severe actions in the COVID-19 cases [1]. It is established that patients with both previous and newly developed hyperglycemia face worse outcomes, longer stays in direct intensive care, and higher mortality rates. This leads to the need to unravel the relationship between glucose metabolism and COVID-19 disease pathogenesis [2]. Random blood glucose (RBG) is another index employed to assess glucose metabolism: this indicator shows the person's current glycemic level and is frequently applied in clinical practice. However, RBG give only the mice picture of glucose level and has short duration that includes recent meals, stress, and acute illness [3]. For better perspectives of a patient's overall glycemic control for the preceding 2–3 months, practitioners use the hemoglobin A1c (HbA1c) assays. HbA1c is an index of average blood glucose level over the two to three months before the test and helps in assessing chronic hyperglyaemia and complications such as cardiovascular diseases, kidney disease, and neuropathy in diabetics [4].HbA1c is one of the parameters that have been confirmed as being closely associated with a higher risk of post-COVID complications, demonstrating the need for managing blood sugar levels during the disease. However, the correlation between acute glucose fluctuations, as reflected by random blood glucose, and long-term glycemic control, HbA1c, in COVID-19 patients has not been as thoroughly researched [5]. This aspect is important since while RBG provides a clear view of hyperglycemia it does not give the

overall picture of how glycemic control is being done over time. For instance, well-controlled diabetic patients with normal levels of HbA1c may develop stress-induced or infective hyperglycaemia, whereas patients with chronically elevated glucose may register normal RBGs during their hospital stay for various reasons including fasting or the use of particular drugs [7]. The relationship between COVID-19, hyperglycemia, and glycemic control has several physiological processes. SARS-CoV-2 has been associated with pancreatic β-cells dysfunction causing decreased insulin activity and contributing to acute hyperglycemia. Furthermore, cytokine release and stress-related hormone response to COVID-19 can contribute to insulin resistance and worsen hyperglycemia in patients [8]. Therefore, it is relevant to check the RBG levels in COVID-19 patients to look for the signs of acute complications and consider further therapeutic management in diabetic and prediabetic patients. Since glycemic control plays pivotal role in identifying outcomes of COVID-19 patients, the understanding of the relationship between RBC and HbA1 mediates in infected patients could be clinically beneficial [9]. For instance, in case the correlation was proven to be high, measurements of RBG might be adopted to estimate long-term glycemic control in facilities where HbA1c testing is inaccessible. On the other hand, low correlation coefficients will indicate that both RBG and HbA1c are independent indicators and cannot give a full picture of the patient's metabolic dysfunction during COVID-19 [10].

Objective

The basic aim of this study is to find random blood glucose and its correlation with HbA1c level in COVID-19-positive patients.

Methodology

This cross-sectional study was conducted at at Department of Medicine, Venkateshwara Institute of Medical Sciences Gajraula U.P. India during 1st July 2020 to 31 Dec 2022. The study included 185 patients who met the inclusion criteria of the study.

Inclusion Criteria:

- Adult patients ≥18 years of age.
- Laboratory-confirmed COVID-19 infection via RT-PCR.
- Availability of both RBG and HbA1c measurements within 48 hours of admission.

Exclusion Criteria:

- Patients with known endocrine disorders other than diabetes (e.g., Cushing's syndrome, thyroid disorders).
- Patients with chronic kidney disease stage 4 or higher.
- Pregnant women, due to the physiological changes in glucose metabolism during pregnancy.

Data Collection

Data were collected through systematically designed questionnaires which included all information related to demographics, gender, history, and symptoms of disease. Upon admission, random blood glucose levels were measured using a glucometer. HbA1c levels were obtained from venous blood samples, and processed by the hospital laboratory using standardized methods. Both RBG and HbA1c levels were measured within 48 hours of hospital admission to ensure that acute illness did not unduly influence HbA1c measurements.Disease severity (based on oxygen saturation, ICU admission, and need for mechanical ventilation) was also noted. The primary

outcome of interest was the correlation between random blood glucose levels and HbA1c levels in COVID-19-positive patients. The percentage of patients with uncontrolled hyperglycemia (RBG > 200 mg/dL or HbA1c > 6.5%) at the time of admission were also noted.

Statistical Analysis

Data were entered and analyzed using statistical software such as SPSS v29. Descriptive statistics, such as mean and standard deviation, were used to summarize continuous variables, while frequencies and percentages were reported for categorical variables.To assess the correlation between RBG and HbA1c levels, Pearson correlation coefficient was calculated.

Results

Data were collected from 185 patients with a mean age of 58.4±12.3 years and a mean BMI of 28.6±4.5 kg/m². Males constituted 59.5% (n=110) of the sample, while females made up 40.5% (n=75). Out of 185 patients, 45.9% (n=85) had a history of diabetes, while 54.1% (n=100) were non-diabetic. The mean random blood glucose (RBG) level was 194.3±68.5 mg/dL, and the mean HbA1c was 7.8±1.5%, indicating a notable degree of acute and chronic hyperglycemia among the patients.

Table 1: Baseline Characteristics of Study Population (n = 185)

Variable	Mean (SD)	Frequency (%)
Age (years)	58.4±2.3	
Body Mass Index (BMI) (kg/m²)	28.6±4.5	
Male	–	110 (59.5%)
Female		75 (40.5%)
History of Diabetes		85 (45.9%)

Non-diabetic	100 (54.1%)
Random Blood Glucose (RBG) (mg/dL)	194.3±68.5
HbA1c (%)	7.8±1.5

The glycemic status of the study population revealed that 55.1% (n=102) of patients had a random blood glucose (RBG) level greater than 180 mg/dL, while 44.9% (n=83) had an RBG below 180 mg/dL. Additionally, 62.2% (n=115) of patients had an HbA1c level greater than 6.5%, indicating poor long-term glycemic control, while 37.8% (n=70) had an HbA1c below 6.5%.

Table 2: Glycemic Status of Patients (n = 185)

Glycemic Status	Frequency (%)
RBG > 180 mg/dL	102 (55.1%)
RBG < 180 mg/dL	83 (44.9%)
HbA1c > 6.5%	115 (62.2%)
HbA1c < 6.5%	70 (37.8%)

In the overall patient group (n=185), the correlation coefficient was 0.63 ($p < 0.001$), indicating a moderate correlation. In diabetic patients (n=85), the correlation was stronger, with an r-value of 0.71 ($p < 0.001$). Among non-diabetic patients (n=100), the correlation was weaker but still significant, with an r-value of 0.52 ($p < 0.01$).

Table 3: Correlation Between Random Blood Glucose and HbA1c

Patient Group	Correlation Coefficient (r)	p-value
Overall (n = 185)	0.63	< 0.001
Diabetic patients (n = 85)	0.71	< 0.001
Non-diabetic patients (n = 100)	0.52	< 0.01

The analysis of clinical outcomes revealed that patients requiring ICU admission had significantly higher mean random blood glucose (RBG) levels (215.6±72.1 mg/dL) and HbA1c levels (8.3±1.7%) compared to non-ICU patients (RBG 183.1±65.8 mg/dL, HbA1c 7.5±1.4%), with p-values of < 0.01 for RBG and 0.02 for HbA1c. Mortality was also associated with higher RBG (224.8±78.4 mg/dL) and HbA1c (8.4±1.8%) compared to survivors (RBG 182.6±61.5 mg/dL, HbA1c 7.6±1.4%), with p-values of < 0.001 for RBG and 0.01 for HbA1c. Patients with severe disease had higher RBG (208.3±70.2 mg/dL) and HbA1c (8.1±1.6%) than those with mild/moderate disease (RBG 177.2±63.9 mg/dL, HbA1c 7.5±1.3%), with p-values < 0.05 for both markers.

Table 4: Comparison of Clinical Outcomes by Glycemic Status

Outcome	RBG (mg/dL) Mean (SD)	HbA1c (%) Mean (SD)	p-value
ICU Admission (n = 60)	215.6±72.1	8.3±1.7	< 0.01 (RBG), 0.02 (HbA1c)
Non-ICU Admission (n = 125)	183.1±65.8	7.5±1.4	
Mortality (n = 40)	224.8±78.4	8.4±1.8	< 0.001 (RBG), 0.01 (HbA1c)
Survivors (n = 145)	182.6±61.5	7.6±1.4	
Severe Disease (n = 85)	208.3±70.2	8.1±1.6	< 0.05 (RBG & HbA1c)
Mild/Moderate Disease (n = 100)	177.2±63.9	7.5±1.3	

Discussion

The findings of this study highlight a significant correlation between random blood glucose (RBG) and hemoglobin A1c (HbA1c) levels in COVID-19-

positive patients. This relationship was particularly strong in patients with pre-existing diabetes, suggesting that in this group, acute hyperglycemia (as indicated by RBG) closely reflects chronic glycemic control (HbA1c). However, a weaker correlation in non-diabetic patients suggests that acute hyperglycemia during COVID-19 infection may not always indicate long-term poor glucose control, but rather, a transient response to the infection and associated stress [11].Our results demonstrated a moderate overall correlation between RBG and HbA1c ($r = 0.63$, $p < 0.001$). This correlation was stronger in diabetic patients ($r = 0.71$, $p < 0.001$) compared to non-diabetic individuals ($r = 0.52$, $p = 0.01$). These findings are consistent with previous research, which shows that RBG and HbA1c tend to align more closely in individuals with chronic hyperglycemia due to diabetes, as their glucose levels are persistently elevated. For non-diabetic patients, the weaker correlation may reflect the impact of acute physiological stress caused by COVID-19 infection, which can lead to transient hyperglycemia unrelated to long-term glucose regulation.

This distinction between diabetic and non-diabetic patients is clinically important. In non-diabetic individuals, acute hyperglycemia during COVID-19 may not signify underlying diabetes but rather a stress response, driven by the body's inflammatory and immune responses. This phenomenon, often referred to as "stress-induced hyperglycemia," has been documented in various acute illnesses and is associated with worse outcomes, even in non-diabetic individuals [14].Elevated RBG and HbA1c levels were both associated with worse clinical outcomes, including higher rates of ICU admission, severe disease, and mortality. Patients with RBG > 180 mg/dL were significantly more likely to be admitted to the ICU (mean RBG 215.6 mg/dL) or to die (mean RBG 224.8 mg/dL), compared to those with lower RBG levels. Similarly, patients with HbA1c > 6.5% had more severe disease

courses, including higher rates of ICU admission and mortality [15] . These findings suggest that both acute and chronic hyperglycemia are important predictors of adverse outcomes in COVID-19 patients.The association between hyperglycemia and poor outcomes in COVID-19 can be attributed to several factors [16]. First, hyperglycemia impairs immune function, reducing the body's ability to fight infection. Second, elevated glucose levels promote inflammation and oxidative stress, exacerbating the "cytokine storm" often observed in severe COVID-19 cases. Third, hyperglycemia is associated with endothelial dysfunction and coagulopathy, both of which contribute to the thrombotic complications seen in critically ill COVID-19 patients [17].The moderate correlation between RBG and HbA1c suggests that both markers provide valuable but distinct information about a patient's glycemic status during COVID-19 infection. While RBG reflects the immediate metabolic state, HbA1c offers insights into chronic glucose control [18]. Clinicians should consider both measurements in managing COVID-19 patients, particularly in those with diabetes or other metabolic disorders.This study has several limitations [19]. First, it is a cross-sectional study, and as such, it does not capture the dynamic changes in glucose levels that may occur during the course of COVID-19 infection. Future longitudinal studies are needed to assess how glucose levels fluctuate over time and how these changes relate to patient outcomes.

Conclusion

It is concluded that both random blood glucose (RBG) and HbA1c levels are important markers in predicting the severity and outcomes of COVID-19 in infected patients, particularly those with pre-existing diabetes. The study found a moderate correlation between RBG and HbA1c, with both elevated levels being associated with higher ICU admission rates and mortality.

Therefore, monitoring and managing glycemic levels is critical in improving clinical outcomes in COVID-19 patients.

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