Hyperglycemia and Mortality in Critically Ill Patients with COVID-19: A Retrospective Study

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Abstract:

Background and Aims: Hyperglycemia has been linked to adverse outcomes in COVID-19 patients, and poor glycemic control may contribute to a higher risk of poor outcomes and death in COVID-19 patients. We hypothesise that hyperglycemia may contribute greatly to COVID-19 mortality, and we aim to assess the association between hyperglycemia and mortality in critically ill COVID-19 patients. **Methods:** This retrospective study included sixty COVID-19 patients admitted to the COVID-19 ICU from July 2020 to July 2021. Patients were divided into four groups based on random blood sugar at admission to the COVID-19 ICU. The number of deaths in each group was recorded. The data collected was analysed using the statistical package SPSS version 15.0 (SPSS Inc., Chicago, 1L), and a Fisher exact test was performed to find out the association between hyperglycemia and mortality in critically ill COVID-19 patients. **Results:** The frequency and percentage of mortality in various groups were derived based on random blood sugar on admission to the COVID-19 ICU. The Fisher exact test showed no significant association between the random blood sugar level and mortality in critically ill COVID-19 patients ($P > 0.001$). The frequency and percentage of the demographic profile of the participants ($N = 60$) were obtained, and the median + SD age in years was 48 + 16. **Conclusion:** Among the sixty patients who were investigated, 58.3 percent of them survived, and our study showed no significant association between random blood sugar levels and mortality in critically ill COVID-19 patients.

Keywords: Hyperglycemia, COVID-19, Glycemic, ICU.

Key Messages:

Hyperglycemia and many other factors like male sex, other co-morbidities, non-white ethnicity, obesity, and low socioeconomic groups may worsen the prognosis of patients with COVID-19. Thus, further studies identifying other risk factors associated with hyperglycemia, COVID-19 infection, and mortality can be established.

Introduction:

Since December 2019, coronavirus disease 2019 (COVID-19) has become a raging global pandemic. [1]Given that the pandemic of COVID-19 is unresolved, it is necessary to identify the important features of COVID-19. Several observational studies have provided clinical evidence that uncontrolled hyperglycemia may lead to a higher mortality rate in COVID-19 patients. [2, 3] Poor glycemic control without diagnosed diabetes may still contribute to poor outcomes and death in COVID-19 patients. [4] Considering the causality between hyperglycemia and the outcome of COVID- 19, we aim to gather evidence on the association between hyperglycemia and mortality in critically ill COVID-19 patients.

Methods:

A retrospective study was conducted after obtaining due permission from the institute's Scientific Advisory Committee (NSAC) and the approval of the institute Ethics Committee. All COVID-19 patients admitted to the COVID-19 ICU, NEIGRIHMS, Shillong, from July 2020 to July 2021 and fulfilling the inclusion criteria were included in the study. Patients with diabetes, with no random blood sugar at the time of COVID-19 ICU admission and patients with key clinical information missing were excluded from the study. The cases were retrieved from the records (department/MRD) of the COVID-19 patients admitted to the COVID-19 ICU.

All demographic parameters and random blood sugar levels were recorded. Patients were divided into four groups. Group A included patients whose random blood sugar level was below 140 mg/dl. Group B included patients whose random blood sugar level was between 140 mg/dl and 180 mg/dl. Group C included patients whose random blood sugar level was between 180 mg/dl and 250 mg/dl. Group D included patients whose random blood sugar level was more than 250 mg/dl.

The number of deaths in each group, treatment given, and complications that occurred in each group during the ICU stay were recorded. The data collected was analysed using the statistical package SPSS version 15.0 (SPSS Inc., Chicago, 1L), and the results were expressed in percentage, proportion, mean, and standard deviation. A Fisher exact test was performed to find out the association between hyperglycemia and mortality in critically ill COVID-19 patients.

Results:

After excluding patients with diabetes mellitus and pre-existing cardiac, liver, and kidney diseases, 60 confirmed critically ill COVID-19 patients were included in the analysis. Based on the random blood sugar on admission to the COVID ICU, the frequency and percentage of participants in various groups were derived (Table 1). The Fisher exact test showed no significant association between the random blood sugar level and mortality in critically ill COVID-19 patients (P > 0.001) (Table 2). The

frequency and percentage of the demographic profile of the participants (N = 60) were obtained, and the median ± SD age in years was 48 ± 16 (Table 3). There was no significant difference in association between the random blood sugar level and complications developed in these critically ill COVID-19 patients (Table 4).

Discussion:

Among the sixty patients who were investigated, 58.3 percent survived. Our study showed no significant association between random blood sugar levels and mortality in critically ill COVID-19 patients.

Reported studies state that COVID-19 with hyperglycemia is considered a direct predictor of poor prognosis and an increased risk of death. [5, 6, 7] Our study showed no association between blood sugar level and mortality, which may be due to differences in clinical care, small sample size, type of evaluation, or experience of the evaluator.

Studies showed that fasting blood sugar at admission is an independent predictor of mortality in patients with COVID-19. [8] In the present study, random blood sugar at the time of admission to the COVID-19 ICU was utilised to predict mortality, and this parameter could have been altered by recent glucose-containing intravenous fluid and food intake. Studies report that steroids aggravate hyperglycemia [9, 10] and 86.7 percent of our patients were on steroids.

Hyperglycemia and other factors may worsen the prognosis of patients with COVID-19. The UK national record noticed other factors like male sex, other co-morbidities, non-white ethnicity, and low socioeconomic groups had higher mortality among diabetic patients with COVID-19. [11] Studies assessing the link between body mass index and COVID-19 infection reported a worse outcome for obese diabetic patients after COVID-19 infection. [12, 13, 14] Thus, further studies identifying other risk factors associated with hyperglycemia, COVID-19 infection, and mortality can be established.

The strength of the study is that the study on hyperglycemia and mortality in COVID-19 critically ill patients includes patients from the north-east region of our country. Limitations include the study being a single centre, small number of patients being investigated, and blood sugar level taken at the time of ICU admission instead of hospital admission.

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References:

1. Yang Y, Cai Z, Zhang J. Hyperglycemia at admission is a strong predictor of mortality and severe/critical complications in COVID-19 patients: a meta-analysis. Bioscience reports. 2021;41(2): BSR20203584.
2. Ceriello A. Acute hyperglycaemia: a 'new'risk factor during myocardial infarction. European Heart Journal. 2005; 26(4):328-31.
3. Lazzeri C, Bonizzoli M, Batacchi S, Di Valvasone S, Chiostri M, Peris A. The prognostic role of hyperglycemia and glucose variability in covid-related acute respiratory distress Syndrome. diabetes research and clinical practice. 2021;175: 108789.

4. Bode B, Garrett V, Messler J, McFarland R, Crowe J, Booth R, et al. Glycemic characteristics and clinical outcomes of COVID-19 patients hospitalized in the United States. Journal of diabetes science and technology. 2020;14(4):813-21.
5. Singh AK, Singh R. Hyperglycemia without diabetes and new-onset diabetes are both associated with poorer outcomes in COVID-19. Diabetes research and clinical practice. 2020;167: 108382.
6. Coppelli A, Giannarelli R, Aragona M, Penno G, Falcone M, Tiseo G, et al. Hyperglycemia at hospital admission is associated with severity of the prognosis in patients hospitalized for COVID-19: the Pisa COVID-19 study. Diabetes care. 2020;43(10):2345-8.
7. Somasundaram NP, Ranathunga I, Ratnasamy V, Wijewickrama PS, Dissanayake HA, Yogendranathan N, et al. The impact of SARS-Cov-2 virus infection on the endocrine system. Journal of the Endocrine Society. 2020;4(8):bvaa082.
8. Wang S, Ma P, Zhang S, Song S, Wang Z, Ma Y, et al. Fasting blood glucose at admission is an independent predictor for 28-day mortality in patients with COVID-19 without previous diagnosis of diabetes: a multi-centre retrospective study. Diabetologia. 2020;63(10):2102-11.
9. Saad AF, Chappell L, Saade GR, Pacheco LD. Corticosteroids in the management of pregnant patients with coronavirus disease (COVID-19). Obstetrics & Gynecology. 2020;136(4):823-6.
10. Singh AK, Majumdar S, Singh R, Misra A. Role of corticosteroid in the management of COVID-19: A systemic review and a Clinician's perspective. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020;14(5):971-8.
11. Holman N, Knighton P, Kar P, O'Keefe J, Curley M, Weaver A, et al. Risk factors for COVID-19-related mortality in people with type 1 and type 2 diabetes in England: a population-based cohort study. The lancet Diabetes & endocrinology. 2020;8(10):823-33.
12. Tchang BG, Askin G, Sahagun A, Hwang J, Huang H, Mendelsohn Curanaj FA, et al. The independent risk of obesity and diabetes and their interaction in COVID-19: a retrospective cohort study. Obesity. 2021;29(6):971-5.
13. Cariou B, Hadjadj S, Wargny M, Pichelin M, Al-Salameh A, Allix I, et al. Phenotypic characteristics and prognosis of inpatients with COVID-19 and diabetes: the Coronado study. Diabetologia. 2020;63(8):1500-15.
14. Agarwal S, Schechter C, Southern W, Crandall JP, Tomer Y. Preadmission diabetes-specific risk factors for mortality in hospitalized patients with diabetes and coronavirus disease 2019. Diabetes Care. 2020;43(10):2339-44.

Table 1:
Frequency and percentage of patients in various groups based on random blood sugar on admission to the COVID ICU (N = 60).

Group	RBS (mg/dl)	Frequency	Percentage
A	<140	35	58.3
B	140-180	14	23.3
C	180-250	3	5.0
D	>250	8	13.3

RBS = Random Blood Sugar

Table 2:
Association between the random blood sugar level and mortality in critically ill COVID-19 patients (N = 60)

RBS (mg/dl)	Mortality		p- value (Fisher exact test)
	Survivors N=35(%)	Non- Survivors N=25 (%)	
<140	24 (68.6)	11 (31.4)	
140-180	6 (42.9)	8 (57.1)	
180-250	1 (33.3)	2 (66.7)	
>250	4 (50)	4 (50)	0.26

RBS = Random Blood Sugar

Table 3:
Demographic profile of the participants (N = 60)

Variables	Frequency	Percentage
Gender		
Male	35	58.3
Female	25	41.7
Age (In years)		
21-36	17	28.3
37-47	14	23.3
48-59	14	23.3
>60	15	25
Median ± SD (Age in years)	48 ±16	
Steroids Treatment		
Yes	52	86.7
No	8	13.3

Survival Status		
Yes	35	58.3
No	25	41.7
Complications		
Yes	58	96.7
No	2	3.3

Table 4:
Association between the random blood sugar level and complications developed in critically ill COVID-19 patients (N = 60)

RBS (mg/dL)	**Complications**		**p-value (Fisher exact test)**
	Yes N=58 (%)	**No N=2 (%)**	
<140	33 (94.3)	2 (5.7)	
140-180	14 (100)	0	
180-250	3 (100)	0	
>250	8 (100)	0	1

RBS = Random Blood Sugar