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Original research article

Estimation of glycemic gap to predict adverse outcome in critically ill patients with diabetes in a tertiary care hospital

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Abstract

Introduction: Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia several distinct types of DM are caused by complex interaction of genetic and environmental factors. Glycated hemoglobin (A1C)-Glycated hemoglobin (A1C, hemoglobin A1C, HbA1c) is the most widely used clinical test to estimate mean blood glucose. It is used to diagnose diabetes and to monitor the efficacy of treatment. **Aim:** To estimate Glycemic Gap for prediction of adverse outcomes and to use it as prognostic tool in assessing critically ill diabetes patients. **Method:** We investigated 41 patients, who were known case of Diabetes Mellitus on treatment, admitted to medicine department of SSGH, Vadodara. After clinical history and through clinical examination patients fulfilling inclusion criteria were enrolled and prospective observational study was undertaken. **Results:** In majority (23 (56.10%) of patients, glycemic gap (mg/dL) was <60. Glycemic gap (mg/dL) was >=60 in only 18 out of 41 patients (43.90%). Mean value of glycemic gap (mg/dL) of study subjects was 73.1 ± 78.23 with median (25th-75th percentile) of 50(38-93). **Conclusion:** The glycemic gap is a tool that may be used to assess the severity and prognosis of patients with type 2 diabetes admitted with critical illness.
Keywords: Glycemic gap, critically ill, diabetes, adverse outcome

Introduction

Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia several distinct types of DM are caused by complex interaction of genetic and environmental factors. Depending on the etiology of DM factors contributing to hyperglycemia includes reduced insulin secretion, decreased glucose utilization and increased glucose production [1].

Glycated hemoglobin (A1C)-Glycated hemoglobin (A1C, hemoglobin A1C, HbA1c) is the most widely used clinical test to estimate mean blood glucose. It is used to diagnose diabetes and to monitor the efficacy of treatment [2].

Stress-induced hyperglycemia (SIH) has been independently associated with an increased risk of mortality in critically ill patients without diabetes. However, it is also necessary to consider preexisting hyperglycemia when investigating the relationship between SIH and mortality in patients with diabetes [3-6]. We therefore assessed whether the gap between admission glucose and A1C derived average glucose (ADAG) levels could be a predictor of mortality in critically ill patients with diabetes. Glycemic gap is a marker of this excursion in patients with diabetes. It can be used to predict adverse outcomes in patients with diabetes admitted to the ICU. The glycemic gap, defined as the difference between blood glucose at ICU admission and the estimated mean blood glucose derived from HbA1c values, is associated with worse prognosis in specific populations of critically ill patients, such as patients with acute myocardial infarction, community acquired pneumonia, and hepatic abscess Moreover, higher glycemic gap is associated with higher hospital mortality in critically ill patients with DM, but its value as a prognostic tool in mixed medical-surgical sample of critically ill subjects is unknown [7-9]. The purpose of the current research is to estimate Glycemic Gap for prediction of adverse outcomes and to use it as prognostic tool in assessing critically ill diabetes patients.

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Methodology

We investigated 41 patients, who were known case of Diabetes Mellitus on treatment, admitted to medicine department of SSGH, Vadodara. After clinical history and through clinical examination patients fulfilling inclusion criteria were enrolled and prospective observational study was undertaken. Study duration was ten months [February 2021 to November 2021]. Information was collected through prepared proforma for each patient and informed Consent was obtained from each participants. The study protocal was approved by Institutional Ethics Committee of Baroda Medical College.

Inclusion criteria

Known Diabetic Patients (Critically ill) admitted to MICU in age between 18- 65yrs with following signs and symptoms.

Critically ill patients, according to qSOFA (Sequential Organ assessment Score) score, satisfying anyone of the criteria.

1. Respiratory rate >=22.
2. Altered Mentation (GCS<=15).
3. Systolic blood pressure <=100 mmhg.

Exclusion criteria

1. Age.
2. Hypoglycemia at admission.
3. Diagnosis of diabetic ketoacidosis/Hyper osmolar hyperglycemic coma.
4. On treatment with corticosteroids.
5. Freshly diagnosed Diabetes Mellitus in SSGH.

Results

21(51.22%) patients were females and 20(48.78%) patients were males. Mean value of age(years) of study subjects was 53.9 ± 8 with median (25th-75th percentile) of 55(50-60).

Distribution of presenting symptoms of study subjects

Presenting symptoms	Frequency	Percentage
Altered sensorium	8	19.51%
Vomiting	5	12.20%
Diarhoea	4	9.76%
Convulsion	2	4.88%
Dyspnea	30	73.17%
Pedal oedema decreased UOP	4	9.76%
Unable to move right upper limb and lower limb	1	2.44%
Chest pain	5	12.20%
Lowerlimb weakness	1	2.44%
Cough	10	24.39%
Weakness	3	7.32%
Fever	16	39.02%
Pedal oedema	9	21.95%
Giddines	1	2.44%
Gabhrahat	1	2.44%

In majority (30(73.17%)) of patients, dyspnea was present followed by fever (16(39.02%)), cough (10(24.39%)), pedal oedema (9(21.95%)), altered sensorium (8(19.51%)), vomiting (5(12.20%)), chest pain (5(12.20%)), diarhoea (4(9.76%)), pedal oedema decreased UOP (4(9.76%)), weakness (3(7.32%)) and convulsion (2(4.88%)).

Descriptive statistics of glycemic parameters of study subjects

Glycemic parameters	Mean ± SD	Median (25th-75th percentile)	Range
Random blood sugar(mg/dL)	289.39 ± 97.77	261(220-312)	197-632
Estimated average glucose(mg/dL)	210.02 ± 56.73	189(177-249)	85-355
HbA1C (%)	9.03 ± 1.85	8.2(7.8-10.3)	6.4-14

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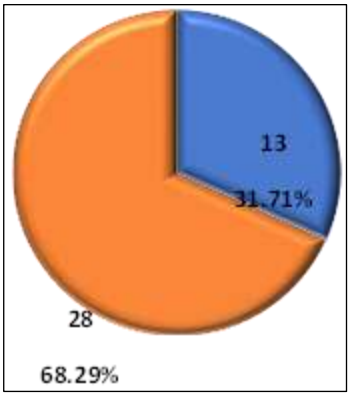
Distribution of glycemic gap (mg/dL) of study subjects.

Glycemic gap(mg/dL)	Frequency	Percentage
<60	23	56.10%
>=60	18	43.90%
Mean ± SD	73.1 ± 78.23	
Median (25th-75th percentile)	50(38-93)	
Range	-92-306	

In majority (23 (56.10%)) of patients, glycemic gap (mg/dL) was <60. Glycemic gap(mg/dL) was >=60 in only 18 out of 41 patients (43.90%). Mean value of glycemic gap (mg/dL) of study subjects was 73.1 ± 78.23 with median (25th-75th percentile) of 50(38-93).
In majority (22(53.66%)) of patients, infection was present followed by AKI (20(48.78%)), cardiac failure (13(31.71%)), acute respiratory failure (10(24.39%)), ARDS (7(17.07%)) and shock (6(14.63%)). MODS was seen in only 1 out of 41 patients (2.44%).

Distribution of mortality of study subjects



Association of demographic characteristics with mortality

Demographic characteristics	Death (n=13)	Discharge (n=28)	Total	P value
Gender				
Female	7 (53.85%)	14 (50%)	21 (51.22%)	0.819‡
Male	6 (46.15%)	14 (50%)	20 (48.78%)	
Age(years)				
Mean ± SD	55.46 ± 7.5	53.18 ± 8.28	53.9 ± 8.02	
Median (25th-75th percentile)	59 (51-61)	55 (50-60)	55 (50-60)	0.403*
Range	40-64	30-62	30-64	

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Range	40-64	30-62	30-64	

Distribution of gender was comparable between non-survivors and survivors. (Female:- 53.85% vs 50% respectively, Male:- 46.15% vs 50% respectively) (p value=0.819). Mean ± SD of age(years) in non-survivors was 55.46 ± 7.5 and survivors was 53.18 ± 8.28 with no significant association between them. (p value=0.403).

Distribution of glycemic gap (mg/dL) of study subjects

Glycemic gap (mg/dL)	Frequency	Percentage
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Mean ± SD	73.1 ± 78.23	

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In majority (22(53.66%)) of patients, infection was present followed by AKI (20(48.78%)), cardiac failure (13(31.71%)), acute respiratory failure (10(24.39%)), ARDS (7(17.07%)) and shock (6(14.63%)). MODS was seen in only 1 out of 41 patients (2.44%).

Discussion

Distribution of other outcome was comparable between glycemic gap {<60 and >=60}. (MODS:- 0% vs 5.56% respectively (p value=0.439), AKI:- 52.17% vs 44.44% respectively (p value=0.623), Cardiac failure:- 34.78% vs 27.78% respectively (p value=0.632)). Comparable with study done by Liao Wen *et al*. [10] who studied 518 patients admitted in ICU, where optimal glycemic cut off was taken 80mg/dl. Patients with a glycemic gap ≥ 80 mg/dL had significantly higher ICU and hospital mortalities and higher incidences of major complications compared with patients who had a glycemic gap <80 mg/dL, whereas in our study it was >=60 mg/dl. In the study Sandeep Donagaon *et al*. [11], 200 patient were enrolled, where glycemic gap cut off was taken as 43.31 mg/dL, 45.26 mg/dL and 39.12 mg/dL were associated with increased likelihood of ICU mortality, MODS and ARF whereas in our study it glycemic cut off was >=60mg/dl, Associated with increased likelihood of ARDS, Infection, ARF, ICU mortality but with MODS, Cardiac failure, AKI outcome was comparable with glycemic GAP<60mg/dl. In a study by Chen *et al*. [12], 203 patients were enrolled, glycemic gap of ≥40 mg/dL was found to be discriminatory for adverse outcomes in patients with CAP. Whereas in our study it was >=60mg/dl. In a study Liao *et al*. [13], 425 diabetic patients were enrolled for Acute heart failure (AHF) and Acute respiratory failure (ARF), Patients with glycemic gap levels >43 mg/dL had higher rates of all-cause death than those with glycemic gap levels ≤43 mg/dL, whereas in our study glycemic cut off was taken has >=60mg/dl, where there was significant increased likelihood Acute respiratory failure (ARF), ARDS, Infection, Shock and Mortality but with MODS, Cardiac failure (AHF) Acute kidney injury (AKI) outcome was comparable with glycemic GAP < 60mg/dl.
Previously, studies also have showed that glycemic gap is associated with adverse outcomes in patients having diabetes admitted with liver abscess[14]; and acute myocardial infarction [15]. As the sample size of the study was limited, so the inference of the study cannot be applied to community as larger sample size is needed. Notably, different management approaches between physicians may have influenced the study outcomes.

Conclusion

Our Study demonstrated higher glycemic gap (≥60mg/dL) were significantly associated with an increased risk Acute Respiratory Distress Syndrome (ARDS), Infection, Shock, Acute respiratory failure, (ARF) as well as ICU mortality. but with MODS, Cardiac failure (AHF) Acute kidney injury (AKI) outcome was comparable with glycemic GAP<60mg/dl. The glycemic gap is a tool that may be used to assess the severity and prognosis of patients with type 2 diabetes admitted with critical illness.

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