



CORRELATION OF ADMISSION BLOOD GLUCOSE WITH THE SEVERITY OF SEPSIS IN NON DIABETIC PATIENTS

General Medicine

Dr. Jauzy Akram	Junior Resident, Department of General Medicine, Hind Institute of Medical Sciences and Hospital, Safedabad, Barabanki, U.P.
Dr. Ravneesh Rana Singh	Professor And Head, Department of General Medicine, Hind Institute of Medical Sciences and Hospital, Safedabad, Barabanki, U.P.
Dr. Shwetambari Tiwari	Junior Resident, Department of Community Medicine, Hind Institute of Medical Sciences and Hospital, Safedabad, Barabanki, U.P.

ABSTRACT

Aim- The study was conducted to find the co-relation of admission blood glucose with the severity of sepsis in non-diabetic patients. **Material and Methods-** We analyzed 312 cases with sepsis. Patients were classified into two groups according to their HbA1c at admission. Patients were further categorized according to admission blood glucose into three groups and severity of sepsis were analyzed. **Results-** Out of 312 cases morbidity was significantly higher in patients with admission blood glucose levels <70 mg/dl (40.5%) and >300 mg/dl (43.6%) as compared to other admission blood glucose level groups. Outcomes were better in those having admission blood glucose levels in 70-140 mg/dl range (17.2%). **Conclusion-** A significant relationship of admission blood glucose levels even in non diabetic and pre diabetic patients was seen with sepsis severity and progression with blood glucose range <70 and >200 mg/dl. Such patients should be aggressively treated and monitored.

KEYWORDS

Admission Blood Glucose, Sepsis, Non-Diabetic, Pre-Diabetic

Sepsis is a life threatening condition that arises when the body's response to infection causes injury to its own tissues and organs and an important cause of morbidity and mortality in critically ill patients. We have different scores like APACHE II and SOFA to determine the severity and prognosticate the subsequent outcome of septic patients. It is known that diabetic patients have worst outcomes, however the correlation of severity of sepsis with glucose at admission in non diabetics needs to be evaluated. With this objective in mind, we did this study in 312 patients who presented to our institute with sepsis between September 2021 and October 2022.

MATERIAL AND METHODS-

This study was conducted at Hind Institute of Medical Sciences, Barabanki which is a tertiary care hospital catering to a large population in the North Eastern part of Uttar Pradesh from September 2021 to October 2022. A total of 312 patients were considered for the study using consecutive sampling technique. All the patients of age group between 18-85 years who were admitted with clear diagnosis of sepsis were enrolled for study. Any pre existing or newly detected cases of Diabetes Mellitus with HbA1c >6.5 were excluded from the study. All glucose levels were measured prior to administration of corticosteroid (if required).

Detailed history and examination was performed on the patients and appropriate lab tests were performed after due consent of the patient. Ethical approval was obtained from the institutional ethical committee before starting the study.

Demographic, clinical, and physiologic data was collected in a pre-structured pro-forma.

Blood Glucose (BG)

level was measured at admission and it was divided into following categories:

- **Group 1:** Blood glucose level <70 mg/dl
- **Group 2:** Blood glucose level 70-199 mg/dl
- **Group 3:** Blood glucose level >200 mg/dl

HbA1C was measured using Mindray's enzymatic assay. Severe sepsis was taken as Sepsis complicated by organ dysfunction which could progress to septic shock¹.

Septic shock was taken as a subset of sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities².

Inclusion criteria

- Age group 18 to 85 years
- Patients with suspected or documented sepsis (presence of at least

- one organ dysfunction)
- Consenting to participate in study

Exclusion criteria

- Newly detected case of Diabetes mellitus with HbA1C >6.5
- Any pre-existing cases of diabetes mellitus even with good control

Statistical Analysis:

Non Diabetic patients were divided into two groups according to HbA1c into Pre Diabetic (HbA1c 5.7-6.5) and those with HbA1c <5.7 and further classified into three groups according to admission blood glucose. Differences between the two groups were compared using Chi Square test and ANOVA.

At 95% confidence interval, 'p' value less than 0.05 was considered to be significant. The data entry was done in Microsoft Excel spreadsheet and the final analysis was done with the use of SPSS version 29.

RESULTS:

Demographic data is as follows:

Table 1: Demographic profile of patients enrolled in the study

SN	Characteristic	Total	HbA1 <5.7	HbA1c 5.7-6.5
1.	Mean age±SD (Range) [Median age; Interquartile range] in years	49.28±16.19 (18-85) [50; 35.25-63.00]	48.18 (18-85) 48	51.47 (18-81) 55
2.	Sex-Male:Female	166 (53.2%): 146 (46.8%)	115(53.24 %), 101 (46.75%)	51(53%), 45(46.87%)
3.	Occupation			
	Housewife	114 (36.5%)	79(36.5%)	35(36.5%)
	Farmer/Unskilled labour	83 (26.6%)	57.45(26.5 %)	25.5(26.6%)
	Shopkeeper/ Businessman	43 (13.8%)	29.8 (13.8%)	13(13.8%)
	Student	37 (11.9%)	25.7 (11.9%)	11.4(11.9%)
	Service	13 (4.2%)	9.072 (4.2%)	4.0(4.2%)
	Retired	11 (3.5%)	7.56(3.5%)	3.36(3.5%)
	Skilled labour	7 (2.2%)	4.9(2.2%)	2.1(2.2%)
	Unemployed	4 (1.3%)	2.59(1.3%)	1.2(1.3%)
4.	Place of residence			

	Rural	158 (50.6%)	109.29 (50.6%)	49(51.04%)
	Urban	154 (49.4%)	106.71(49.4%)	47.0(48.95%)
5.	Socioeconomic class			
	Low	169 (54.2%)	117 (54.2%)	52(54.2%)
	Middle	143 (45.8%)	98.92 (45.8%)	44(45.8%)

Age of patients ranged from 18 to 85 years. Mean age of patients was 49.28±16.19 years. Median age of patients was 50 years. Majority of patients were males (53.2%) 166. There were 146 (46.8%) females. Sex-ratio (M:F) of sepsis patients was 1.14:1. Maximum number of patients (n=114; 36.5%) were housewives followed by farmer/unskilled laborers (n=83; 26.6%), shopkeepers/businessmen (n=43; 13.8%), students (n=37; 11.9%), service (n=13; 4.2%), retired (n=11; 3.5%), skilled laborers (n=7; 2.2%) and unemployed (n=4; 1.3%) respectively.

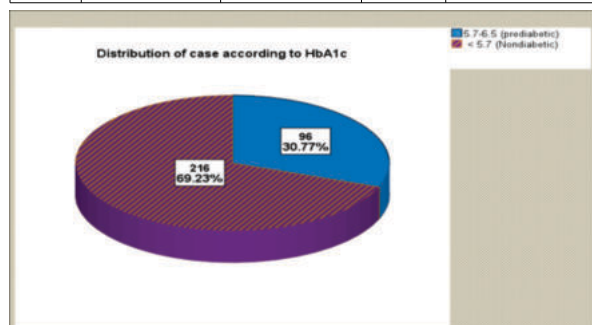
Table 2(a): Distribution of Cases according to at admission blood glucose levels

Blood glucose levels	Count	Percentage
Group 1 (<70 mg/dl)	37	11.9
Group 2 (70-199 mg/dl)	108	34.6
Group 3 (> 200mg/dl)	167	53.5
Mean RBS ± SD (Range) mg/dl	237.71 ± 148.50 (20 – 830)	

Blood glucose at admission levels ranged from 20 to 830 mg/dl. Maximum patients had RBS >200 mg/dl (Group 3: n=167; 53.5%) followed by 70-199 mg/dl (Group 2: n=108; 34.6%), <70 mg/dl (Group 1: n=37; 11.9%) shown in table 2(a).

Table 2 (b): Distribution of Cases according to HbA1c

SN	HbA1c	Group	No.	%
1.	<5.7%	A	216	69.23%
2.	5.7-6.5%	B	96	30.76%



HbA1c ranged from 3.5-6.5. Maximum patients had HbA1c <5.7 (Group A: n=216) followed by HbA1c 5.7-6.5 (Group B: n=96) shown in table 2(b).

Table 3: Distribution of cases according to Sepsis Status

SN	Severity	No.	%
1.	Sepsis	179	57.4
2.	Severe Sepsis	83	26.6
3.	Septic shock	50	16.0

Majority (n=179; 57.4%) patients had sepsis, followed by severe sepsis (n=83; 26.6%) and septic shock (n=50; 16%) respectively.

Table 4: Distribution of sepsis severity in patients with HbA1c 5.7-6.5% and HbA1c <5.7

SN	Sepsis Severity	HbA1c 5.7-6.5% (n=96)	HbA1c <5.7 (216)
1.	Sepsis	45(46.9%)	134(62.0%)
2.	Severe sepsis	30(31.3%)	53(24.5%)
3.	Septic shock	21(21.9%)	29(13.4%)

There were 96 patients of pre diabetic status (HbA1c 5.7-6.5%). A total of 45(46.9%) pre diabetic patients had sepsis, a total of 30(31.3%) patients had severe sepsis and 21(21.9%) patients were in septic shock. There were 216 patients with HbA1c <5.7. A total of 134(62.0%) of these had sepsis, a total of 53(24.5%) patients had severe sepsis and 29(13.4%) patients were in septic shock.

Table 5: Association between blood glucose levels with severity at admission

Severity	Blood glucose level in septic severity					
	Group 1 (<70 mg/dl)		Group 2 (70-199 mg/dl)		Group 3 (> 200mg/dl)	
	Count	Percentage	Count	Percentage	Count	Percentage
Sepsis	21	56.8	70	64.8	88	52.7
Severe Sepsis	14	37.8	23	21.3	46	27.5
Shock	2	5.4	15	13.9	33	19.8

Table 6: Association between blood glucose levels with SOFA Score at admission

SOFA Score category	Blood glucose level in SOFA Score					
	Group 1 (<70 mg/dl)		Group 2 (70-199 mg/dl)		Group 3 (> 200mg/ dl)	
	Count	Percentage	Count	Percentage	Count	Percentage
<= 9	8	21.6	43	39.8	49	29.3
10 - 14	12	32.4	30	27.8	48	28.7
15 - 24	17	45.9	35	32.4	70	41.9
Chi-square = 5.897 (df = 4) ; p = 0.207 [Non significant]						
Mean ± SD	14.84 ± 5.17		12.36 ± 5.52		13.69 ± 5.58	
F (ANOVA) = 3.396; p = 0.035 [Significant]						

Table 7: Association between blood glucose level with APACHE II Score at admission

APACHE II Score category	Blood glucose level in APACHE II Score					
	Group 1 (<70 mg/dl)		Group 2 (70-199 mg/dl)		Group 3 (> 200mg/dl)	
	Count	Percentage	Count	Percentage	Count	Percentage
< 18	3	8.1	32	29.6	41	24.6
18 - 29	25	67.6	53	49.1	84	50.3
> 29	9	24.3	23	21.3	42	25.1
Chi-square = 7.660 (df = 4) ; p = 0.105 [Non significant]						
Mean ± SD	24.57 ± 6.34		22.22 ± 7.57		23.81 ± 7.87	
F (ANOVA) = 1.975; p = 0.141 [Non Significant]						

Table 8: Distribution of cases according to Outcome

SN	Variable	Total	HbA1c <5.7	HbA1c 5.7-6.5
1.	Death	96(30.8%)	63(29.2%)	33(34.4%)
2.	Discharge	188(60.3%)	135(62.5%)	53(55.2%)
3.	LAMA	13(4.2%)	7(3.2%)	6(6.3%)
4.	Referred	15(4.8%)	11(5.1%)	4(4.2%)

There were 96 (30.8%) deaths. A total of 188 (60.3%) patients were discharged after recovery. A total of 13 (4.2%) left against medical advice and 15 (4.8%) were referred to other facilities.

Table 9: Association of At Admission Glucose levels with Outcome

Outcome	Blood glucose levels					
	Group 1 (<70 mg/dl)		Group 2 (70-199 mg/dl)		Group 3 (> 200mg/dl)	
	Count	Percentage	Count	Percentage	Count	Percentage
Death	15	40.5	22	20.4	59	35.3
Discharge	18	48.6	79	73.1	91	54.5
Lama	2	5.4	3	2.8	8	4.8
Referred	2	5.4	4	3.7	9	5.4
Chi-square = 12.011 (df = 6) ; p = 0.062 [Non significant]						

Death rates were significantly higher in Groups 1 and 3 (40.5% and 35.3% respectively) as compared to that in Group 2(20.4%) whereas discharge after recovery was seen in significantly higher proportion of Group 2 patients as compared to that in Groups 1 and 3 thereby showing a significant association between at admission glucose levels and outcome (Table 9).

DISCUSSION

In the present study, we found lowest severity of sepsis in the middle range of admission blood glucose, with peaks in both the <70 mg/dl and >200 mg/dl i.e., a U-shaped curve-relationship of admission blood glucose levels. Morbidity was significantly higher in patients with at admission blood glucose levels <70 mg/dl (40.5%) and >200 mg/dl (35.4%) as compared to other admission blood glucose level groups. Poor outcomes were less in those having at admission RBS levels in

70-199 mg/dl range (20.4%).

Mitsuyama *et al*⁵ in their study reported a mortality rate as high as 71.4% in patients with severe hyperglycemia as compared to only 8.7% in euglycemic patients. However, Chao *et al*⁶ despite reporting a significant association of admission glucose levels with mortality in sepsis patients found this relationship to be J-shaped (severity of sepsis increasing at an exponential rate with increasing blood glucose levels) and did not find the burden of mortality to be significantly higher in lower blood glucose levels. The reason for this difference could be the fact that they had considered the lower blood glucose levels as ≤ 100 mg/dl as against ≤ 70 mg/dl in the present study. It may be noted that in the present study we recorded blood glucose levels as low as 20 mg/dl at admission which otherwise is considered to be a severe hypoglycemic condition having high mortality risk⁷. Thus, a U-shaped curve relationship between admission blood glucose levels and mortality as seen in the present study could be considered as maintainable and should not be seen as an exception but instead the studies showing a J-shaped curve relationship might be having inadequate or no representation of hypoglycemic patients.

In another study in Japan, conducted by Kushimoto *et al*⁸, a significant association of hypoglycemia with disease severity in terms of SOFA scores and severity was seen, primarily in non-diabetic patients. Our study endorses their findings in Indian population. Similarly, Sun *et al*⁹ and Lu *et al*¹⁰ in China found in their studies that there was a high association of ICU mortality with glycemic variability within 6 hours of admission. We also found association of adverse outcome with blood glucose levels at admission (<70 mg/dl and >200 mg/dl) in our population.

In Pre diabetic patients (HbA1c 5.7-6.5) also we found that the number of patients in severe sepsis (31.3%) and septic shock (21.9%) was significantly higher as compared to patients with HbA1c <5.7 (Non Diabetics). 24.5% had severe sepsis and (13.4%) developed septic shock. Mortality rates were also found to be significantly higher in patients with HbA1c 5.7- 6.5 which was 34.4% in contrast with those with HbA1c <5.7 which was 29.2%.

CONCLUSIONS

Although the outcome in ICU admitted sepsis patients is related to multiple factors, we found that admission blood glucose levels also has a significant association with severity of sepsis and can be helpful in risk stratifying the patients.

- Though it is a common knowledge that diabetic patients have far worse outcomes in Sepsis but it is to be noted that even Non Diabetic and Pre Diabetic patients have poor outcomes if they have blood sugar (<70 and >200 mg/dl) at admission.
- Therefore patients of sepsis presenting with extremes of blood glucose at admission should be aggressively treated and monitored even if they have been Non Diabetic as per their records.

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Nil

Conflict Of Interest:

None

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Limitations Of Our Study:

We studied the population coming to our tertiary care centre located in the North Eastern region of Uttar Pradesh, India. It was a single centre study. More studies in other regions across Indian subcontinent are needed to further support the point.

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