DOI: https://doi.org/10.53350/pjmhs20221612860

ORIGINAL ARTICLE

Study of Stress Hyperglycemia as a Prognostic Factor in Acute Ischemic Stroke at a Tertiary Care Hospital

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ABSTRACT

Background: The second most prevalent cause of disability and death worldwide, stroke is silently taking on the characteristics of an epidemic. Almost 85% of the all strokes are ischemic strokes.

Objective: To assess the stress hyperglycemia as a prognostic factor in acute ischemic stroke at a tertiary care hospital.

Design of the Study: It was a case control study.

Place and Duration of Study: This study was conducted at the Department of medicine & Allied Services Hospital Lahore from March 2022 August 2022.

Patients and Methods: Total 100 patients with Computerized Tomography (CT) Brain evidence of acute ischemic stroke who met the inclusion criteria were included in the study. At admission, a thorough history was taken and clinical examination was performed. The National Institutes of Health Stroke Scale (NIHSS scale) was used to measure the patient's neurological state. Fasting Blood sugar (FBS) and Glycosylated Hemoglobin (HBA1c) were performed. Patients' functional recovery was measured by comparing their NIHSS scores on the day of admission and after 7 days in the hospital.

Results of the Study: Most of the patients enrolled in our study had age of 61 to 70 years. In study sample 56% of patients were male and 44% were female. Out of 100 patients 56 had stress hyperglycemia and 44 were without stress hyperglycemia. Functional recovery was greater in patients with normoglycemia than in patients with stress hyperglycemia (based on differences in NIHSS score on day one and day seven). The mortality was observed to be 9.2% in patients who had stress hyperglycemia. The mean NIHSS scores was 3.45±1.64 in patients with stress hyperglycemia and 4.50 ± 1.05 was in participants with normoglycemia.

Practical Implication: The present study was carried out to know whether stress hyperglycemia can be a prognostic marker in patients of acute ischemic stroke.

Conclusion: When compared to patients with stress hyperglycemia, functional recovery was better in patients with normoglycemia. This study demonstrates that patients with normoglycemia had greater functional recovery as compared to patients with stress hyperglycemia, as measured by the difference between the NIHSS scores. As a result, patients with normoglycemia had better outcomes than those with stress hyperglycemia.

Keywords: Stress hyperglycemia, Normoglycemia, Acute Ischemic Stroke, Prognostic Factor, NIHSS

INTRODUCTION

Stroke is defined as an acute neurologic insult caused by either brain ischemia or bleeding, with symptoms typically appearing suddenly and continuing for more than 24 hours.[1] The global prevalence of stroke places it as the second leading cause of mortality and the third leading cause of disability.[2] Pakistan's estimated yearly stroke incidence is 250/100,000. Stroke mortality in Pakistan is expected to double by 2030 as the older population grows in size. Stroke incidence increases as people age. Strokes are the second leading cause of death and the third largest cause of disability in the world.[3]

The stroke's outcome is influenced by several causes like severity, predisposing factor and care facilities. Hyperglycemia at admission is a potential modifiable factor in stroke prognosis. Research from both clinical and experimental settings indicates that hyperglycemia at admission adversely affects neurological and short-term outcomes in ischemic stroke.[4,5] It has been suggested that the initial hyperglycemia seen in stroke may not always be the result of type 2 diabetes mellitus, but rather the result of a stress response mediated in part by the release of cortisol and norepinephrine.[6]

The presence of hyperglycemia as a result of stress can be found in approximately 20–50% of patients who have presented with acute ischemic stroke.[7] Patients admitted with hyperglycemia after suffering an acute ischemic stroke have a higher risk of death while hospitalised, resulting in greater costs and spending more time in the hospital, according to a recent study.[8] Many patients with acute stress situations, such as stroke, may acquire stress hyperglycemia even if they have never had diabetes mellitus before. Studies in both humans and animals have linked stress hyperglycemia to an increased risk of mortality and poor recovery following a stroke.[9,10]

A rationale for the pursuit of strict glucose control has been offered by the identification of hyperglycemia as a marker for poor functional recovery and in hospital mortality. Reduced mortality and infection rates are two outcomes that benefit from glucose control that is both immediate and long-term. Having stress hyperglycemia upon hospital admission has been linked to a threefold increased risk of poor functional recovery and death in stroke patients.[11] Patients with hyperglycemia but no diabetes mellitus (representing stress hyperglycemia) were at a higher risk of death than those with diabetes mellitus.[12]

There are no definitive guidelines on whether or not this hyperglycemia has to be treated, despite the abundance of research and current updates on stroke. The effects of stress hyperglycemia on the outcome of acute ischemic stroke are still up for debate. Therefore, the current study compared normoglycemic and diabetes mellitus patients presenting with acute ischemic stroke to those with stress hyperglycemia to evaluate the existence of stress hyperglycemia and its effect on neurological recovery at 3 months.

PATIENTS AND METHODS

Study Design: Case control study

Study Setting & Duration: This study was conducted at the Department of medicine & Allied Services Hospital Lahore from March 2022 August 2022.

Sample Size: The study includes 100 hospitalised patients with CT brain confirmation of acute ischemic stroke who also meet all the criteria for inclusion and exclusion.

Definition of study Variables:

Stress hyperglycemia: A patient with blood glucose > 155 mg/dl was considered having stress hyperglycemia and was included in cases group.

Without Stress hyperglycemia: Those patients having blood sugar <155 mg/dl were labeled as without stress hyperglycemia and taken in control group.

Data Collection Procedure: All Patients have given written their informed consent. Each subject underwent a thorough clinical examination, severity assessment using the NIHSS score, and full history evaluation. The definition of an ischemic stroke according to CT brain was either a normal scan or a recent infarct in the clinically significant area on a scan performed within 72 hours of the stroke. All patients' blood sugar levels were assessed upon admission which was used to divide them into cases and control group. Patients in the control group have normal fasting blood sugar, postprandial blood sugar, and HbA1c upon admission. Patients in the cases group have stress hyperglycemia (>155 mg/dl) and normal levels of FBS and HbA1c.

The clinical history assessment was part of the baseline clinical data. Data was collected from patients that meet the inclusion and exclusion requirements. On the day of admission and the seventh day after admission, the patient's condition was evaluated using the NIHS scale, and functional recovery was evaluated using the difference score.

Data Analysis: With the SPSS software for Windows Version 22.0, statistical analysis was performed. Categorical variables were displayed as percentages and frequency. Chi Square test was used to observe the relationship between categorical variables. Mean and Standard Deviation were used to represent continuous variables. A single-tailed t test was used to compare groups. Paired t test was used to compare two groups within one another. P values below 0.05 are regarded as significant.

STUDY RESULTS

Out of 100 patients 56 had stress hyperglycemia and 44 were without stress hyperglycemia. The RBS level on admission day was 156.98 mg/dl, FBS in next 24 hours was 124.80 mg/dl, HbA1c was 5.27%. In this study there was no significant associations observed between age and stress hyperglycemia. Out of study sample 35 males were affected with stress hyperglycemia and 21 females were affected from stress hyperglycemia with a p value <0.03. Out of 57 patients with stress hyperglycemia death was occurred in 5 patients and no death was observed in patients without stress hyperglycemia, this difference was statistically significant. In patients with stress hyperglycemia mean NIHSS was 64.41±12.01 and in those without stress hyperglycemia mean NIHSS was 65.27 ± 9.68 with statistically insignificant difference.

Table 1: Distribution of stress hyperglycemia

Stress Hyperglycemia	Frequency	Percent
Absent	44	44.0
Present	56	56.0
Total	100	100.0

Table 2: Mean values of RBS, FBS, PBS & HBA1c at admission

Variables	Mean	Std. Deviation	Minimum	Maximum	Range
RBS on admission day	156.98	43.19	87.00	335.00	248.00
FBS in next 24 hours	124.80	23.70	14.00	267.00	253.00
HBA1c	5.27	0.49	4.00	6.20	2.20

In the study mean FBS values was higher for patients who had stress hyperglycemia (131.88 ± 29.35) than without stress hyperglycemia (115.80 ± 6.57). This difference was statistically significant. The mean value of HbA1c was 5.42± 0.46 in those with stress hyperglycemia and 5.07± 0.47 which was highly significant.

When RBS values were measured on day 7, it was observed that mean RBS was 132.38 ± 36.52 and while its mean level was 156.98 ± 43.19 on the day of admission. There was significant reduction in RBS at 7th day when compared to 1st day RBS with mean difference of 24.60 which is statistically significant. On day 1, the average NIHSS score was 11.61 2.57. On day 7, the average NIHSS score in patients was 7.01 2.99, with a mean difference of 4.60. This variation was statistically noteworthy. For example, Day 1 showed higher NIHSS scores than Day 7. In this study there is mean hyperglycemia of (3.45±1.64) and (4.50±1.05) in those without stress hyperglycemia and this is statistically significant.

Table 3: Comparison of age, gender and outcome with the group of stress hyperglycemia and without stress hyperglycemia

Variables	Characterstics	Without Stress Hyperglycemia	Stress Hyperglycemia	Total
Age	< 40	1	3	4
	41 -50	2	2	4
	51-60	10	15	25
	61-70	18	26	44
	71-80	11	6	17
	> 80	2	4	6
	Mean± Sd	65.27± 9.68	64.41±12.01	
Gender	Male	18	35	53
	Female	26	21	47
Outcome	Survived	44	51	95
	Died	0	5	5

Table 4: comparison of FBS with the group of stress hyperglycemia and without stress hyperglycemia

Parameters	Without Stress Hyperglycemia		Stress Hyperglycemia		
	Mean	Std. Deviation	Mean	Std. Deviation	
FBS in next 24 hours	115.80	6.57	131.88	29.35	P<0.001
HbA1c	5.07	0.47	5.42	0.46	P<0.000

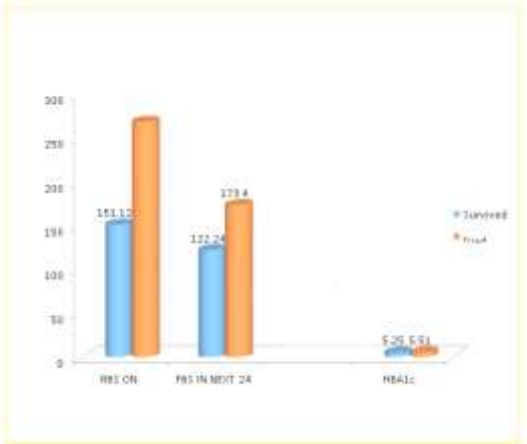

Figure 1: Comparison of glycemic parameters with survived and died outcomes

Table 5: comparison of NIHSS and RBS score at day 1 and on 7th day

Variables	Characterstics	Mean	Std. Deviation	Mean difference	Paired tTest	P Value
NIHSS	At Admission	11.61	2.57	4.60	18.47	P<0.000,HS
	At 7th Day	7.01	2.99			
RBS	At Admission	156.98	43.19	24.60	3.747	P<0.000,HS
	At 7th Day	132.38	36.52			

Table 6: comparison between NIHSS day 1 and 7 with the group having stress hyperglycemia and withotut stress hyperglycemia

Stress Hyperglycemia	Difference between NIHSS Day1 & 7			Unpaired t Test		
	N	Mean	Std. Deviation	t Value	P Value	Inference
Absent	44	4.50	1.05	3.709	P<0.000	HS
Present	56	3.45	1.64			

DISCUSSION

Most of the participants in this study were between the ages of 61 and 70 years. The mean age for both sexes in patients with stress hyperglycemia was 64.41±12.01, while it was 65.27±9.68 in those without it. This is consistent with findings of Athanasia et al. they found that the diabetic group's average age was greater at 77.4±6.4 years compared to the non-diabetic stroke group's 77.3±5.2 years.[13]

In the present study, predominantly male patients were affected in all the two groups. Akbar DH et al showed predominance in male among the diabetic and non-diabetic stroke patients and female predominance among the new hyperglycemic stroke patients.[14]

A total of 100 patients were included in our study, 56 of them had stress hyperglycemia with RBS > 155 mg/dl at admission and were included as cases of stress hyperglycemia. Therefore, 56% of the participants in our study had stress hyperglycemia. Similarly 31% of subjects in Kamel Abdelazi'z et al. study in 2013 had stress hyperglycemia.[15] The percentage of stress hyperglycemia in the Abdul Hameed et al. study in 2012 was 36.8%.[16]

Patients with stress hyperglycemia had higher NIHS scores than patients with normoglycemia. The mean NIHSS score for the stress hyperglycemia group on day 1 was 11.61±4.60. On day 7, the mean NIHSS score for the group with stress hyperglycemia was 3.45±1.64, while it was 4.50±1.05. There was a statistically significant difference here. According to Kolawole W et al. study's admission hyperglycemia is a significant predictor for short-term outcomes since the median NIHSS score was 14.00 in the hyperglycemic group compared to 8.00 in the normoglycemic group. After three months, the NIHSS score evaluation was 9.90±2.43, 12.41±1.78 and 15.93±2.14, respectively, with differences of 4.161, 3.094 and 2.20 between the normoglycemic, stress hyperglycemic, and diabetes groups that were determined to be statistically significant with a p value of 0.001. This demonstrated clearly that the functional recovery was slower for the diabetes and stress hyperglycemic groups compared to the normoglycemic group.[17] These observations suggest that group A consisted of patients with bad prognosis as more the NIHSS score, worse is the prognosis or slow recovery and increased mortality. Similar observation reported study done by Prasad et al.[18] In present study we observed that, increased mean RBG and high NIHSS score on admission and high NIHSS on discharge are the parameters highly significant with stress hyperglycemia and their association adds to bad prognosis.

In this study out of 56 patients with stress hyperglycemia 5 of them died. The mortality rate was 9.2%. Due to proper management of stress hyperglycemia with insulin from the time of admission, mortality was lower in our study. High RBG and FBS values were present in all 5 of these patients.

These patients had normal HbA1C levels. As a result, research demonstrates that individuals with stress hyperglycemia have a lower mortality rate than those with normoglycemia. Therefore, stress hyperglycemia affects those who have recently suffered an acute ischemic stroke and aids in determining their prognosis for functional recovery and outcome for mortality. A high blood glucose level in acute ischemic stroke has been theorized to have an adverse effect on the ischemic brain. Stress hyperglycemia has been shown in numerous studies to worsen the severity of ischemic brain injury.[19] The danger of cerebral edema and stroke mortality are made more likely by hyperglycemia, which is mediated by anaerobic metabolism and the ensuing acidosis. This has led to the discovery of a link between the level of serum glucose immediately following a stroke and subsequent morbidity and mortality.[20]

There are some limitations of the study which include sample size of the study that may not be an appropriate representative of the population. Future research will need a multi-centric strategy with a larger number of patients over a longer period of time in order to determine the precise association between the various clinical-pathological forms of acute stroke and hyperglycemia. This study was single-centered and short-term.

CONCLUSION

When compared to patient's with stress hyperglycemia, functional recovery was better in patients with normoglycemia. This study demonstrates that patients with normoglycemia had greater functional recovery as compared to patients with stress hyperglycemia, as measured by the difference between the NIHSS scores. As a result, patients with normoglycemia had better outcomes than those with stress hyperglycemia. According to the study, there may be a link between stress-induced hyperglycemia and worse stroke outcomes.

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