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STRESS HYPERGLYCEMIA AS PREDICTOR FOR SHORT TERM OUTCOME IN ACUTE ISCHEMIC STROKE

General Medicine

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ABSTRACT

Stroke is one among the leading causes of long term morbidity and the second leading cause of mortality worldwide. Diabetes mellitus is a well know risk factor for stroke, increasing the risk of mortality and morbidity with stroke compared to non diabetic patients. Acute stroke can cause stress hyperglycemia which may have an impact on the outcome. Thus, hyperglycemia foretells increased mortality and morbidity among the other variables that affect the outcome of a stroke, such as the subtype and severity of the stroke. This study was done to assess the presence of stress hyperglycemia and its effects on acute ischemic stroke. **Materials and methods:** A prospective and comparative study was conducted at Narayana Medical College and Hospital, Nellore, on 110 acute ischemic stroke patients. National institute of health stroke scale (NIHSS) and Capillary blood glucose (CBG) were noted from all the study participants, at admission and at follow up period of 3 months. Patients were categorised into normoglycemic, stress hyperglycemia and diabetes mellitus groups based on FBS, PPBS, HbA1C values. Short term functional recovery among the 3 groups were assessed. **Results:** Stress hyperglycemia was observed in 26.37% of the study patients. Relatively less functional recovery at the end of 3 months was observed in stress hyperglycaemic patients compared to normoglycemic stroke patients. Stress hyperglycemia can be considered as a significant prognostic marker of short term outcome in ischemic stroke. **Conclusion:** Stress hypeglycemia has poor short term outcome on morbidity with ischemic stroke. Hence, adequate management of glycemic levels at presentation can have a better short term outcomes of ischemic stroke.

KEYWORDS

Stroke, acute ischemic stroke, stress hyperglycemia, National institute of health stroke score, Diabetes mellitus.

INTRODUCTION

Stroke is one among the leading causes of long term morbidity and the second leading cause of mortality worldwide. The clinical syndrome of stroke is defined by the World Health Organization as rapidly developing clinical signs of focal or global disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death, with no other apparent cause other than a vascular origin1. Most common type of stroke being ischemic in nature, other types are hemorrhagic stroke at intracerebral or subarachnpoid space and lacunar strokes[2].

Derranged glucose metabolism and ischemic stroke are related in both directions. One the one hand, diabetes mellitus is a well know risk factor for stroke, increasing the risk of mortality and morbidity with stroke compared to non diabetic patients3. Acute stroke, on the other hand, may result in changes in glucose metabolism, which may have an impact on the outcome4. Thus, hyperglycemia foretells increased mortality and morbidity among the other variables that affect the outcome of a stroke, such as the subtype and severity of the stroke[5].

The hyperglycemia in acute ischemic stroke can be as a result of stress hyperglycemia, denovo diabetes, or pre-existing diabetes. Stress hyperglycaemia generally refers to a transient hyperglycaemia during illnesses and restricted to individuals without prior evidence of DM and usually resolves spontaneously after that acute phase of illness. Acute hyperglycemia in stroke is possibly due to the stress response mediated by raised levels of glucocorticoids and activation of sympathetic autonomic nervous system, which further contributes to increased glycogenolysis, gluconeogenesis, proteolysis, and lipolysis and thus leading to glucose production. Hyperinsulinemia and insulin resistance are additional side effects of increased epinephrine[6].

Till date , controversies do exist regarding the concept of stress hyperglycemia and its impact on acute ischemic stroke. Hence , this study was done to assess the presence of stress hyperglycemia and its effects on acute ischemic stroke.

AIMS AND OBJECTIVES

1. To observe the incidence of stress hyperglycemia in acute ischemic stroke.

2. To assess the prognostic significance of stress hyperglycemia on short term morbidity of stroke.

MATERIALS AND METHODS

A prospective and comparative study was conducted at Narayana Medical College and Hospital, Nellore, on 110 patients satisfying inclusion and exclusive criteria, over a period of 16 months from May 2021- October 2022.

Inclusion criteria: Patients with acute ischemic stroke presenting to emergency department or outpatient department within 24 hours of onset of symptoms, and who attended a follow up at the end of 3rd month.

Exclusion criteria:

1. Patients with hemorrhagic stroke/lacunar stroke.
2. Patients with recurrent stroke.
3. Patients with age <18 years.

Computed tomography (CT) or magnetic resonance imaging (MRI) scans of the brain was done to confirm the diagnosis of acute ischemic stroke. Detailed history of present and past illnesses were collected, clinical examination was done and applied National institute of health stroke scale (NIHSS) on all the study participants, at admission to assess the severity of stroke. Blood sugars (capillary blood glucose(CBG)) of all the study patients, at the time of presentation were checked and noted. Complete hemogram, serum creatinine, fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, and fasting lipid profile were done in all the patients. Stress hyperglycaemia was defined as a blood sugar level of more than or equal to 140mg/dl. All the study patients were categorised in to three groups based on their glycemic status, as follows.

1.Nondiabetic and Normoglycemic at presentation- CBG<140 mg/dl, normal FBS, PPBS, HbA1C
2. Hyperglycemia at presentation (CBG ≥140mg/dl) , normal HbA1C and without past history of diabetes mellitus.
3. Hyperglycemia at presentation (CBG ≥140mg/dl) with diabetes mellitus - denovo/known case.

CBG and National Institutes of Health stroke scale was done on all the patients at the end of 3rd month at follow up, to assess the residual diability.

STATISTICAL ANALYSIS

The descriptive statistics were used to summarize the data. Continuous measurements are presented as mean ±SD (min-max) and categorical

measurements are presented in numbers (%). A p-value of <0.05 was considered to be statistically significant. All the statistical analysis were done using SPSSCversion 25.0.

RESULTS

Total 110 patients were studied, of which 38 (34.54%) were females and 72 (65.46%) were males

Table 1: Age distribution

AGE (years)	NUMBER OF PATIENTS	PERCENTAGE
18-40	5	4.54%
41-50	20	18.18%
51-60	41	37.28%
61-70	32	29.1%
>70	12	10.9%

Table 2: Risk factors noted in study patients

RISK FACTOR	NUMBER OF PATIENTS	PERCENTAGE
Diabetes mellitus	52	47.27%
Systemic hypertension	38	34.54%
Coronary artery disease	12	10.9%
Dyslipidemia	49	44.54%
Alcohol	41	37.27%
Smoking	32	29.1%

Table 3: CBG at presentation

CBG (mg/dl) at presentation	NUMBER OF PATIENTS	PERCENTAGE
< 140	43	39.1%
≥ 140	67	60.9%

Table 4: Glycemic status of study patients

GLYCEMIC STATUS	NUMBER OF PATIENTS	PERCENTAGE
Normoglycemia	43	39.09%
Stress hyperglycemia	29	26.37%
Diabetes mellitus	38	34.54%

Among the Diabetes mellitus group, 16 were denovo diagnosed based on the FBS, PPBS and HbA1C levels and the remaining 22 were known diabetic patients.

Table 5: Mean CBG, FBS, PPBS, HbA1C levels at admission

AT ADMISSION	NORMOGLYCEMIC (43 Patients)	STRESS HYPERGLYCEMIA (29 patients)	DIABETES MELLITUS (38 patients)	p value
CBG	118.6 ± 10.4	186.9 ± 16.2	212 ± 28.6	< 0.01
FBS	98.1 ± 5.2	92 ± 10.4	161.2 ± 14.3	< 0.01
PPBS	134.5 ± 6.71	130 ± 6.02	198 ± 19.24	< 0.02
HbA1C	5.4 ± 0.9	5.49 ± 0.72	7.4 ± 0.32	< 0.01

Table 6: NIHSS at admission

NIHSS category	NORMOGLYCEMIC (43 Patients)	STRESS HYPERGLYCEMIA (29 patients)	DIABETES MELLITUS (38 patients)
Minor stroke	9 (20.9%)	2 (6.9%)	0 (0%)
Moderate stroke	6 (13.9%)	5 (17.3%)	1 (2.6%)
Moderate-severe stroke	21 (48.9%)	15 (51.7%)	24 (63.2%)
Severe stroke	7 (16.3%)	7 (24.1%)	13 (34.2%)

Table 7: NIHSS after 3 months, at followup

NIHSS category	NORMOGLYCEMIC (43 Patients)	STRESS HYPERGLYCEMIA (29 patients)	DIABETES MELLITUS (38 patients)
Minor stroke	23 (53.5%)	6 (20.7%)	0 (0%)
Moderate stroke	14 (32.6%)	8 (27.6%)	6 (15.7%)
Moderate-severe stroke	6 (13.9%)	11 (38%)	23 (60.5%)
Severe stroke	0 (0%)	4 (13.7%)	9 (23.6%)

Table 8: Mean NIHSS score at admission and after 3 months

NIHSS score	NORMOGLYCEMIC (43 Patients)	STRESS HYPERGLYCEMIA (29 patients)	DIABETES MELLITUS (38 patients)	p value
At admission	12.4 ± 2.91	16.68 ± 3.02	20.4 ± 2.82	< 0.01
After 3 months	8.34 ± 1.82	13.82 ± 1.58	18.34 ± 2.08	< 0.01
Difference	4.06	2.86	2.06	< 0.01

DISCUSSION

In our study, 34.54% patients were diabetics. Stress hyperglycemia was observed in 26.37% of the study patients. The blood sugar levels of stress hyperglycemia patients returned to normal limits at followup (after 3 months). The cut off range for stress hyperglycaemia was taken as 140 mg/dl. We choose to use this cut off in view of the conclusion made by various studies7, 8, 9 that nondiabetic survivors with an admission level RBS between 121 to 144 mg/dl had a greater risk of poor functional recovery.

At admission, patients with diabetes mellitus and stress hyperglycemia had higher mean NIHSS score than normoglycemic patients, with p value < 0.01 , which is statistically significant. At followup (after 3 months), also patients with diabetes mellitus and stress hyperglycemia had higher mean NIHSS score than normoglycemic patients, with p value < 0.01 , which is statistically significant. Improvement in the NIHSS score in normoglycemic , stress hyperglycemia and diabetic patients were 4.06, 2.86, 2.06 points respectively, with p value < 0.01 (statistically significant).

These observations suggest relatively less functional recovery in stress hyperglycaemic patients compared to normoglycemic patients. Hence stress hyperglycemia can have a poor short term outcome on morbidity with stroke. Supportive to this observation, Kolawole W et al in his study found that the median admission NIHSS was 14.00 in the hyperglycaemic group when compared to 8.00 in the normoglycemic group and also concluded that admission hyperglycaemia is a significant predictor for short term outcomes[10].

Possible mechanism underlying the deleterious effect of hyperglycemia could be because of anaerobic glucose metabolism, which exacerbates intracellular and extracellular acidosis3. Several pathways have been found by which hyperglycemia could exacerbate cerebral damage in ischemic stroke, including impaired recanalization, reduced reperfusion, reperfusion injury, and direct tissue injury.

CONCLUSION

Normoglycemic patients with acute ischemic stroke patients can have hyperglycemia at presentation as a result of stress response. This stress hyperglycemia can affect the severity of stroke at presentation and also can influence the functional recovery in short term basis. Stress hypeglycemia has poor short term outcome on morbidity with ischemic stroke. Hence, adequate management of glycemic levels at presentation can have a better short term outcomes of ischemic stroke.

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