e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(2); 1081-1089

Original Research Article

Study on Clinical Outcome of Stroke and Relation to Admission-Day of Blood Sugar Levels

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Received: 30-12-2022 / Revised: 13-01-2023 / Accepted: 13-02-2023
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Conflict of interest: Nil

Abstract

Background: Ischemic stroke, hemorrhagic stroke, and cerebrovascular anomalies such intracranial aneurysm, AV malformation, and cortical venous thrombosis are all examples of cerebrovascular accident. Stroke is the third most prevalent cause of mortality, behind heart disease and cancer. Stress and diabetes: Strokes caused by hyperglycemia can be fatal and have a bad prognosis. Diabetes increases the risk of stroke by two times compared to non-diabetics. The outcome of a stroke is influenced by a number of risk factors. The ones that are well examined are hyperglycemia, fever, and neuroprotective substances. The purpose of this study is to monitor blood glucose levels in diabetics and non-diabetics within twenty-four hours of the beginning of stroke and to assess the severity and prognosis of hyperglycemia in both groups.

Methods: Between April 2022 and December 2022, 50 patients with acute stroke were admitted to the medicine department at Darbhanga Medical College and Hospital Laheriasarai, Bihar. The NIH stroke scale, or NIHSS, which considers the following clinical findings and assigns precise points for each criterion, is used to determine the severity of stroke for each patient.

Results: Of the 50 patients in our study group, 22 had normal blood glucose levels and 28 had increased blood glucose levels on the day of admission. Another 16 individuals had stress hyperglycemia, and 16 patients had diabetes. Stress hyperglycemia affected one-third of the patients in the ischemic stroke group and one-fifth of the patients in the hemorrhagic stroke group. Patients with euglycemia recovered from acute strokes more quickly. 65 percent of individuals with euglycemia made a good functional recovery. Contrarily, only 3% of patients with admission-day hyperglycemia showed good functional recovery at the conclusion of a 30-day follow-up.

Conclusion: Hyperglycemia on the admission day and stroke severity, magnitude, and outcome are correlated linearly. A larger-sized major stroke and a poor functional result in the form of increased mortality are observed to be associated with combined diabetes and stress hyperglycemia. The outcome of an ischemic stroke is well correlated with the glucose level on the day of admission. A strong predictor of mortality and a poor functional outcome following an acute stroke was an increased glucose level on the admission day. Therefore, prompt restoration of normoglycemia should be promoted even in the absence of strong evidence. In the interim, we must maintain good general stroke care, normal body temperature, fluid balance, and hemodynamics; otherwise, we run the danger of compromising the positive outcome, even in patients with normoglycemia.

Keywords: Hyperglycemia, CVD, Hemorrhagic Shock, Venous Thrombosis.

Introduction

Cerebrovascular accidents are the most common and significant of all adult neurological illnesses. Stroke is the primary cause of at least 50% of neurological illnesses treated in general hospitals[1]. Ischemic stroke, hemorrhagic stroke, and cerebrovascular anomalies such intracranial aneurysm, AV malformation, and cortical venous thrombosis are all examples of cerebrovascular accident [2]. The third most prevalent cause of death, behind heart disease and cancer, is a stroke. The prevalence of stroke has significantly decreased since the development of efficient hypertension medication [3]. Diabetes mellitus is a significant risk factor in the development of stroke due to its link to microvascular and macrovascular disease. The majority of diabetic stroke patients have elevated glycosylated haemoglobin, which indicates that the majority of them have uncontrolled diabetes [4]. Stress and diabetes: Strokes caused by hyperglycemia often have bad results. Diabetes increases the risk of stroke by two times compared to non-diabetics [5]. Diabetes frequently results in hypertension, which increases atherosclerosis and, in turn, promotes intracranial small vessel disease and cardiovascular disease, which, in turn, cause lacunar and embolic infarction, respectively [6]. The most frequent type of stroke, ischemic stroke, which includes TIA, is caused by a blockage that prevents blood flow to the brain's injured regions. Ischemic strokes can be thrombotic or embolic events and are frequently referred to as cerebrovascular accidents (CVA)[7]. The symptoms of the blockage depend more on where it is in the brain than on its origin, although determining the origin is crucial for treating each patient individually and preventing additional strokes [8]. In contrast to an ischemic stroke, an intracerebral hemorrhagic stroke is brought on by a burst blood vessel rather than a blood clot. Blood flow and the delivery of vital nutrients and oxygen to the damaged area of the brain are interrupted by the ruptured vessel. A blood artery rupture may leak blood extremely quickly, which could cause a sudden increase in cerebral pressure, which could cause unconsciousness or death [9]. The outcome of a stroke is influenced by a number of risk factors. Hemorrhagic strokes account for about 10% to 15% of all strokes and have a mortality rate of 40% to 50%. The topics that have received the most research are hyperglycemia, fever, and neuroprotective drugs [10].

Materials and Methods

From April 2022 to November 2022, a total of 50 acute stroke patients who were hospitalised to the Department of Medicine at the Darbhanga Medical College and Hospital in Laheriasarai, Bihar, were examined. Patients should be at least forty years old. Within 24 hours of the commencement of symptoms, patients should have been hospitalised. The patient should be experiencing his or her first cerebrovascular event. Within twenty-four hours following the beginning of stroke, blood sugar readings were taken and included in this study. In patients who received intravenous glucose before or during the trial period and those who were admitted after twenty-four hours following a stroke, it was impossible to find patients with accurate diabetic knowledge. Patients who passed away before it was possible to determine whether they had diabetes or illnesses that presented with symptoms resembling stroke were not included in this study.

Each patient had a thorough history taken, a clinical examination, and a clinical diagnosis delivered. All patients underwent evaluations for blood pressure, ECG, urea, creatinine, electrolytes, haemoglobin, total count, differential count, and deposits in the urine. The NIH stroke scale, or NIHSS, was used to determine each patient's stroke severity. This scale awards points for each of the following clinical findings (NIHSS Table). Within twenty-four hours of the onset of symptoms, venous blood was drawn and sent to a lab for glucose determination once an acute stroke diagnosis had been made clinically. HbA1c testing was done on patients with blood sugar levels greater than 6.1 mmol/l (110 mg/dl) who had no prior history of diabetes. HbA1c depends on how much glucose is exposed to red blood cells. Since the glucose-hemoglobin coupling is comparatively stable, HbA1c builds up during the course of an erythrocyte's lifetime and its concentration reflects the integrated blood glucose concentration over a time frame roughly corresponding to the half-life of an erythrocyte, or six to eight weeks. Therefore, monitoring the total level of diabetes control obtained by HbA1c measurement is helpful.

HbA1c typically ranges from 3.8% to 6.4%. Thus, four groups can be created from the patients. 1. Nondiabetics if blood sugar is less than 6.1 mmol/l (euglycemic). 2. Diabetes history: Individuals with diabetes. 3. HbA1c greater than 6.4%, blood sugar greater than 6.1 mmol/l, and no known history of diabetes recently discovered diabetes. 4. Stress hyperglycemia is defined as blood sugar levels more than 6.1 mmol/l, no prior history of diabetes, and HbA1c less than 6.4%. Following the patients for 30 days, the results were documented and included death, poor, moderate, and satisfactory improvement. Patients with poor outcomes were those who were unable to return to any type of employment, required ongoing residential placement due to a disability, were dependent on others for daily living activities, or had stable deficits without improvement. Patients with a positive outcome were those whose symptoms subsided, who were independent in participating in daily activities, improved in motor function and aphasia, and had no lasting handicap. Patients with a middling outcome were those who performed in the middle of these two groups.

Age, sex, fasting blood sugar, body mass index, and length of diabetes were noted for the patients. A thorough inspection was followed by a clinical assessment of the skin condition. Version 24 of the statistical programme for social sciences was used to examine the data. The data was cleaned, and mistakes were fixed. Means and standards were used to summarise quantitative variables.

Results

33 of the 50 patients had high blood pressure, 14 had diabetes, 7 had high cholesterol, 3 had experienced a previous myocardial infarction, and one woman had atrial fibrillation. One third of the male patients had a history of drinking alcohol, and more than half smoked. Twenty individuals experienced left-sided weakness whereas 30 had right-sided weakness.

Of the 50 patients in our study group, 22 had normal blood glucose levels and 28 had increased blood glucose levels on the day of admission. Stress hyperglycemia and diabetes were identified in an additional 14 individuals. Stress hyperglycemia affected one-third of the patients in the ischemic stroke group and one-fifth of the patients in the hemorrhagic stroke group (Table – 1, 2, 3, 4).

Table 1: Age-wise distribution.

Age (Years)	Male	Female	Total	Percentage
41-50	8	2	10	20%
51-60	14	5	19	38%
61-70	5	5	10	20%
71-80	5	4	9	18%
>80	2	0	2	4%
	34	16	50	100%

Table 2: Risk factors.

Risk factors	Male	Percentage	Female	Percentage	Total
Hypertension	21	63.64%	12	36.36	33
Diabetes	9	60.71%	5	39.29	14
Hypercholesterolemia	5	71.43%	2	28.56	7
Atrial fibrillation	0	0	0	0	0
Coronary artery disease	2	66.66%	1	33.33	3
Smoking	20	100%	0	0	20
Alcohol	13	96.15%	0	0	13

Table 3: Clinical presentation.

Clinical presentation	Male	Percent	Female	Percent	Total
Right hemiplegia	19	69.1%	8	30.9%	27
Left hemiplegia	13	64.1%	7	35.9%	20
Faciobrachial monoplegia	1	40%	1	60%	2
Cerebellarsymptoms	1	100%	0	0	1
Loss of consciousness	16	60.8%	10	39.2%	26
Hemianopia	1	66.6%	0	33.3%	1
Aphasia	11	57.9%	8	42.1%	20
Bladder and Bowel involvement	8	59.3%	5	40.7%	13

Table 4: Glycemic status.

Glycemic status	Total
Euglycemia	22
Stress Hyperglycemia	14
Known Diabetes	8
Newly diagnosed Diabetes	6

The NIH Stroke scale method was used to determine the stroke's severity. When compared to patients who were euglycemic on admission day, hyperglycemic patients had a higher score (17.27 vs. 9.5, respectively), which was statistically significant with p = 0.001. The highest mean NIHSS was seen on the admission day in hyperglycemic patients with newly discovered diabetes. Consequently, a major stroke was caused by having high blood sugar at the time of the stroke (Table – 5).

Table 5: Stroke Severity.

Glycemic status	NIHSS
Euglycemia	9.5
Stress hyperglycemia	16.33
Known diabetes	17.3
Newly diagnosed diabetes	19.4

A brain CT scan was used to determine the lesion's size. Euglycemic individuals tended to have minor infarcts and haemorrhages, whereas hyperglycemic patients tended to have big lesions with edema and midline shift on the day of admission. With p = 0.001, these data were statistically significant. Large-sized infarcts and severe brain injury are caused by hyperglycemia, which also increases anaerobic metabolism, increases brain lactate, impairs mitochondrial function, causes vascular disease, increases free radical production, and increases the expression of c-fos and cox-2. Large haemorrhages and infarcts that have hemorrhagic metamorphosis can occur as a result of hyperglycemia's disruption of the blood-brain barrier (Table – 6, 7).

Table 6: Glycemic status among ischemic and hemorrhagic stroke.

Glycemic status	Ischemic stroke		Hemorrhagic stroke		Total
	Number	Percent	Number	Percent	
Euglycemia	17	77.27	5	22.73	22
Stress hyperglycemia	12	82.14	2	17.86	14
Known diabetes	5	62.5	3	37.5	8
Newly diagnosed diabetes	3	50	3	50	6

Table 7: Size of the lesion.

Glycemic status	Total	Small	Medium	Large
Euglycemia	22	15	4	3
Stress Hyperglycemia	14	1	7	6
Known Diabetes	8	1	3	4
Newly diagnosed diabetes	3	0	3	6

In this analysis of 50 acute stroke patients, euglycemic patients fared better than hyperglycemic patients on the admission day. Patients with euglycemia recovered from acute strokes more quickly. 65 percent of individuals with euglycemia made a good functional recovery. On the other hand, just 3% of hyperglycemic patients who were admitted that day showed good functional recovery at the conclusion of the thirty-day follow-up. Patients with hyperglycemia on entry day had a high rate of early inpatient mortality. In the first thirty days after admission, 40% of hyperglycemic patients passed away. The early case mortality rate was only 15% in the euglycemic patients. Therefore, compared to euglycemic patients, admission day hyperglycemic patients had a 2.5-fold higher risk of early mortality. Twenty-seven percent of admission day hyperglycemic patients and four percent of euglycemic patients had poor outcomes (Table – 8, 9, 10).

Table 8: Clinical outcomes.

Glycemic Status	Total	Death		Poor		Moderate		Good	
		No.	%	No.	%	No.	%	No.	%
Euglycemia	22	4	15.91	1	4.54	3	13.64	14	65.91
Stress Hyperglycemia	14	5	35.71	4	28.57	4	32.14	1	3.54
Known Diabetes	8	4	43.75	2	18.75	2	31.25	0	6.25
Newly diagnosed diabetes	6	3	50	2	33.33	1	16.67	0	0

Table 9: Outcome in stroke subtypes.

Glycemic status			Outcome				Total
			Good	Moderate	Poor	Death	
Hemorrh	Group	Euglycemia	2	1	0	2	5
		Stress hyperglycemia	0	0	1	2	3
		Known diabetes	0	2	1	0	3
		Newly diagnosed diabetes	0	1	2	0	3
	Total		2	2	4	4	14
Infarct	Group	Euglycemia	13	2	1	1	17
		Stress hyperglycemia	1	4	4	3	12
		Known diabetes	0	1	1	3	5
		Newly diagnosed diabetes	0	0	1	2	3
	Total		14	7	5	10	36

Table 10: Outcome of stroke in non-diabetes patients.

		Ischemic stroke		Hemorrhagic stroke	
		Euglycemia	Stress Hyperglycemia	Euglycemia	Stress Hyperglycemia
Total		17	13	5	2
NIHSS		7.62	15.56	14.4	19.8
Death	No.	2	3	2	2
	%	8.82	30.43	40	60
Poor	No.	1	4	0	1
	%	5.58	30.43	0	20
Moderate	No	2	4	1	0
	%	8.82	34.78	30	20
Good	No	13	1	1	0
	%	76.47	4.35	30	0
The average blood glucose level		91.68	144.43	102.12	240.6

With SPSS 24.0, statistical analyses were carried out. For the baseline characteristics, descriptive statistics including mean, median, and standard deviation were calculated. In univariate statistics, the p-value for continuous variables was determined using the Student t-test and Mann Whitney test, while categorical variables were compared using the Chi-Square test. Logistic regression analysis was used to examine the factors that were associated with poor outcome and death at three months. Significant variables were those with a p-value at the univariate level less than 0.05.

Discussion

The National Institute of Health (NIH) in the United States is divided into the National Institute of Neurological Diseases and Stroke (NINDS) (NINDS, 2013). For 44,862 stroke victims, 28 Phase 3 trials financed by NINDS have evaluated stroke therapies since 1977. Drugs, gadgets, surgeries, and behavioural interventions for stroke prevention, acute stroke therapy, and rehabilitation were tested in the trials. The early death rate in the ischemic stroke group was 46.15% in hyperglycemic patients and 8.82% in euglycemic patients. 5.88% of euglycemic and 23.3% of hyperglycemic patients had poor outcomes [11]. Early mortality rates for stress hyperglycemia were 30.43% and for euglycemia were 8.82%. Because of this, this study demonstrates a statistically significant three-and-a-half-fold higher risk of mortality in non-diabetic stress hyperglycemic patients compared to non-diabetic euglycemic individuals.

However, the hemorrhagic group did not show a similar significance. Increased mortality and a high likelihood of impaired functional recovery are associated with higher admission day elevated blood glucose levels [12]. According to Lindsberg PJ, *et al*., 66 percent of all ischemic stroke patients had hyperglycemia. In our study, 56% of patients overall and 55% of patients with ischemic stroke had hyperglycemia detected. In their analysis is known diabetes and newly diagnosed diabetes contributed one-third of cases (33%) [13]. According to a study published in the journal of clinical endocrinology and metabolism, patients with newly discovered hyperglycemia had a greater early mortality rate and a worse functional result than patients with a history of diabetes or normoglycemia.

The same outcomes were found in our research of 100 acute stroke patients [14]. After reviewing 32 related studies, Malmberg K, *et al* [15] came to the conclusion that patients with hyperglycemia had a threefold higher early mortality rate than those with euglycemia. Following hospitalisation for an ischemic stroke, hyperglycemia was linked to a threefold higher 30-day death rate than euglycemia. Admission hyperglycemia after a hemorrhagic stroke was not linked to a greater mortality in either diabetic or non-diabetic patients. In our investigation, early mortality was three and a half times higher in ischemic patients with raised admission day glucose levels than in euglycemic individuals [15].

When compared to patients with euglycemia, hemorrhagic patients with entrance hyperglycemia did not exhibit a statistically significant early mortality. Patients who were not diabetic saw similar outcomes. When compared to euglycemic patients, early death was three and a half times higher in non-diabetic stress hyperglycemic patients who had ischemic stroke [16]. The impact of stress in the diabetic group could not be evaluated since the sugar level prior to the beginning of stroke was unknown. According to the research, individuals with diabetes and stress hyperglycemia have a higher early mortality rate and less successful functional recovery than euglycemic patients [17].

Therefore, it is crucial to quickly assess whether these patients' improve after blood sugar normalisation. Several studies are currently being conducted to see if regulating blood glucose with human recombinant insulin can improve the outcome of strokes. According to research by Scott JF *et al*., giving insulin to hyperglycemic patients increases functional recovery and vital activity in those who have had mild to moderate ischemic strokes. However, other clinical benefits of insulin therapy remain to be determined [18-20].

Conclusion

Hyperglycemia on the admission day and stroke severity, magnitude, and outcome are correlated linearly. A larger-sized major stroke and a poor functional result in the form of increased mortality are observed to be associated with combined diabetes and stress hyperglycemia. There is a high association between admission day glucose level and the outcome in ischemic stroke. A strong predictor of mortality and a poor functional outcome following an acute stroke was an increased glucose level on the admission day.

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