Section: Medicine

Original Research Article

A HOSPITAL BASED PROSPECTIVE STUDY TO MEASURE THE RANDOM BLOOD SUGAR LEVEL IN THE EARLY PHASE OF ISCHEMIC STROKE (WITHIN 24 HOURS OF ONSET) IN BOTH DIABETIC AND NON-DIABETIC AT NEWLY ESTABLISHED TERTIARY CARE CENTER

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Abstract

Background: Stroke is one of the leading causes of death and long-term disability in India. There are several risk factors that determine the outcome of stroke. Diabetics and stress hyperglycemics have severe strokes resulting in poor outcome. The aim of this study to measure the random blood sugar level in the early phase of ischemic stroke (within 24 hours of onset) in both diabetic and non-diabetic at newly established tertiary care center. **Material & Methods:** A hospital based prospective study done on 30 acute ischemic stroke patients admitted in the intensive care unit at Government Medical College, Barmer, Rajasthan, India during one year period. In patients with blood sugar more than 6.1 mmol/l (110 mg/dl)[5] and without a history of diabetes, Hemoglobin A 1c was performed. Then computerized tomography, CT, of the brain was performed in all patients to confirm the diagnosis, detect the type of stroke, detect the size of lesion (small < 5mm; Medium 5 – 10 mm; large > 10 mm or involving more than one vascular territory) and locate the site of lesion. Identify the presence of cerebral edema or midline shift. The patients were followed up for thirty days and outcome in the form of death; poor, moderate and good improvement was recorded. **Results:** Severity of stroke was assessed with NIH Stroke scaling system. Admission day hyperglycemic patients had a higher score when compared to Euglycemic patients, which was statistically significant with $p<0.01$*. Among the admission day hyperglycemic patients uncontrolled diabetes patients had the highest mean NIHSS. Hence an elevated blood sugar at the time of stroke resulted in severe stroke. There positive correlation ($r = 0.68$, $p = 0.01$) between admission day sugar value and the outcome of stroke. Higher admission day elevated blood glucose level has increased mortality and high risk of poor functional recovery. Out of thirty acute stroke patients, euglycemic patients had a better outcome when compared to admission day hyperglycemic patients. **Conclusion:** We concluded that admission day elevated glucose level was a significant predictor of mortality and poor functional outcome after acute stroke. Hence, restoration of normoglycemia as soon as possible should be encouraged.

INTRODUCTION

Stroke is one of the leading causes of death and long-term disability in India. Stroke is an important cause of premature death and disability in low-income and middle-income countries like India, largely driven by demographic changes and enhanced by the increasing prevalence of the key modifiable risk factors.

Cerebrovascular disease or stroke is the fifth commonest among premature deaths in adults and fourth leading cause of death of all cause mortality in India. With both death and disability combined i.e., disability-adjusted life years (DALYs) stroke occupies the fifth position among all causes. Cerebro vascular accident includes ischemic stroke, hemorrhagic stroke, and cerebro vascular anomalies such as intracranial aneurysm, AV malformation and cortical venous thrombosis. Stroke after heart disease, is the second most common cause of death among non-communicable diseases.[1]

Hypertension is common in diabetes and accelerates atherosclerosis which promotes intracranial small vessel disease and heart disease leading to lacunar and embolic infarction respectively. There are several

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risk factors that determine the outcome of stroke. With the introduction of effective treatment for hypertension, there has been a marked reduction in the frequency of stroke.

Diabetes mellitus by virtue of its association with micro vascular and macrovascular disease is an important risk factor in the genesis of stroke.[2] Most of the diabetic patients with stroke have raised glycosylated hemoglobin indicating that most of them have uncontrolled diabetes.

Diabetics and stress hyperglycemics have severe strokes resulting in poor outcome. Stroke is Twice more common in diabetics than in nondiabetics.[3] Diabetes mellitus is an independent risk factor for stroke and one of the important risk factors causing strokes at younger ages. The mechanism is believed to be accelerated atherosclerosis, which can affect vessels in many distributions, including small and large vessels. The aim of this study to measure the random blood sugar level in the early phase of ischemic stroke (within 24 hours of onset) in both diabetic and non-diabetic at newly established tertiary care center.

MATERIALS AND METHODS

A hospital based prospective study done on 30 acute ischemic stroke patients admitted in the intensive care unit at Government Medical College, Barmer, Rajasthan, India during one year period.

Inclusion Criteria

1. Patients should be above the age of 40 years
2. Patients should have been admitted within twenty-four hours of onset of symptoms
3. This should be the first cerebro vascular accident for the patient
4. Blood sugar recorded with in twenty-four hours of the onset of stroke

Exclusion Criteria

1. Patients admitted after twenty-four hours of stroke
2. Those patients who received intravenous glucose before or during study period
3. Patients who died before it could be established whether or not they had diabetes
4. Illness presented with stroke like symptoms

Methods

Complete history was taken, clinical examination was done and clinical diagnosis for each patient was arrived.

Blood pressure measurement, blood sugar, urea, creatinine, electrolytes, hemoglobin, total count, differential count; urine sugar, albumin, deposits; electrocardiogram and chest X ray done for all patients.

The severity of stroke for each patient is calculated based on NIH stroke scale, NIHSS[4] which takes the following clinical findings in to account and each criteria awarded specific points.

Once clinical diagnosis of acute stroke is made venous blood sample is taken, within twenty-four hours of onset of symptoms, and sent to laboratory for glucose estimation.

In patients with blood sugar more than 6.1 mmol/l (110 mg/dl)[5] and without a history of diabetes, Hemoglobin A 1c was performed (Hemoglobin A1c is structurally similar to hemoglobin A except for the addition of glucose). The normal range of Hemoglobin A 1c is 3.8% to 6.4%.[2] Hence the patients can be classified into four groups.

Blood sugar less than 6.1 mmol/l: **Non diabetic (euglycemic)**

History of diabetes: **Known diabetics**

Blood sugar more than 6.1mmol/l, no history of diabetes, and hemoglobin A1c more than 6.4%: **Newly detected diabetics**

Blood sugar more than 6.1 mmol/l, no history of diabetes, and hemoglobin A1c less than 6.4%: **Stress hyperglycemics**

Then computerized tomography, CT, of the brain was performed in all patients to:

Confirm the diagnosis, detect the type of stroke, detect the size of lesion (small < 5mm; Medium 5 – 10 mm; large > 10 mm or involving more than one vascular territory) and locate the site of lesion. Identify the presence of cerebral edema or midline shift.

The patients were followed up for thirty days and outcome in the form of death; poor, moderate and good improvement was recorded.

RESULTS

Our study of thirty patient's majority of them belonged to male sex showing a male preponderance. Majority of the patients, ten were between the age group of 51 to 60. Among the thirty patients 19 had hypertension, 20 had diabetes and 17 had hypercholesterolemia, 2 had previous history of myocardial infarction, and one female patient had atrial fibrillation. More than two third of the male patients were smokers and one half had history of alcohol intake [Table 1,2].

NIHSS is equated to stroke severity and clinical outcome of patient after stroke onset assessed in varying intervals. Severity of stroke was assessed with NIH Stroke scaling system. Admission day hyperglycemic patients had a higher score when compared to Euglycemic patients, which was statistically significant with $p<0.01$*. Among the admission day hyperglycemic patients uncontrolled diabetes patients had the highest mean NIHSS. Hence an elevated blood sugar at the time of stroke resulted in severe stroke [table 3].

Our study clearly shows a positive correlation ($r = 0.68$, $p = 0.01$) between admission day sugar value and the outcome of stroke. Higher admission day elevated blood glucose level has increased mortality and high risk of poor functional recovery (table 4).

In this study of thirty acute stroke patients, euglycemic patients had a better outcome when

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compared to admission day hyperglycemic patients [Table 5].

Table 1: Demographic variables of patients

Demographic variables	No. of patients (N=30)	Percentage
Age groups (yrs)		
40-50 yrs	5	16.66%
51-60 yrs	10	33.33%
61-70 yrs	8	26.66%
>70 yrs	7	23.33%
Gender		
Male	18	60%
Female	12	40%

Table 2: Distribution of patients according to risk factors

Risk factors	No. of patients (N=30)	Percentage
Hypertension		
No	11	36.66%
Yes	19	63.33%
Diabetes mellitus		
No	10	33.33%
Yes	20	66.66%
Dyslipidemia		
No	13	43.33%
Yes	17	56.66%
Smoker		
No	20	66.66%
Yes	10	33.33%
Alcoholic		
No	22	73.33%
Yes	8	26.66%

Table 3: Statistical analysis of stroke severity by NIHSS v/s HbA_1C

Stroke Severity by NIHSS class	HbA1C				Total
	Euglycemic	Known diabetic	Newly Detected	Stress hyperglycemic	
Minor	0	1	0	0	1
Moderate	1	6	3	6	16
Moderate to severe	0	6	0	0	6
Severe	0	6	1	0	7
Total	1	19	4	6	30
P- value	<0.001**				

Table 4: Statistical analysis of stroke severity by NIHSS v/s RBS

Stroke Severity by NIHSS class	RBS		Total
	126-199 mg/dl	>199 mg/dl	
Minor	0	1	1
Moderate	11	5	16
Moderate to severe	1	5	6
Severe	0	7	7
Total	12	18	30
P- value	<0.001*		

Table 5: Comparison of clinical outcome & RBS

Clinical outcome	RBS	
	126-199 mg/dl	>199 mg/dl
Death	0	7
Good	5	3
Moderate	5	2
Poor	2	6

DISCUSSION

There are multiple mechanisms of neuronal damage and blood-brain dysfunction in patients with prolonged stress hyperglycemia. Elevated blood glucose is common in the early phase of stroke and is probably mediated by the increased release of the "stress hormones"–cortisol and epinephrine.

Hyperglycemia detected in the acute stroke phase—regardless the presence of diabetes mellitus—reflects a physiological stress and is a manifestation of relative insulin deficiency, which is related to increased lipolysis.[6] In addition, hyperglycemia in stroke patients may result from an interaction between several hormones including glucagon,

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cortisol, cytokines, and growth hormone, which play a crucial role in blood glucose regulation.[7]

Several mechanisms have been identified by which hyperglycemia could increase brain damage in ischemic stroke and thereby result in unfavorable outcomes. These include endothelial dysfunction, impaired fibrinolysis[8], and increased tendency of red blood cells to form microaggregates.[9] Moreover, hyperglycemia might result in a number of cellular derangements including loss of the blood-brain barrier integrity, increase of excitatory neurotransmitters production, enhancement of anaerobic glycolysis, and induction of oxidative stress. Persistent or poorly controlled hyperglycemia has been shown to reduce cerebral blood flow, increase intracranial pressure, and cause cerebral edema and neuronal death.[10]

Our study showed that majority of the patients, fifteen were between the age group of 51 to 60 years. Increasing age is most powerful risk factor for cerebral infarction, intracerebral hemorrhage and subarachnoid hemorrhage as well as TIA.[11] Men are more at risk for ischemic stroke than woman up to 75 years of age.[11]

Hypertension is a major risk factor for stroke. Hypertension is associated with an increased incidence of both haemorrhagic, ischaemic and lacunar stroke. It is an important predisposing factor not only for cerebral hemorrhage but also for infarction. Both systolic and diastolic pressures contribute to the risk though there is no critical level above which it operates. The reduction of BP by 10-12mmHg systolic and 5-6mmHg diastolic was found to be associated with 38% reduction in stroke incidence. Our study showed that 63.33% of patients had diabetic.

Among the thirty patients 20 had diabetes and 17 had hypercholesterolemia, 2 had previous history of myocardial infarction, and one female patient had atrial fibrillation. Although up to one third of acute stroke patients have either diagnosed or newly diabetic, probably a major proportion of patients have stress hyperglycemia, mediated partly by the release of cortisol and nor epinephrine. It is also a manifestation of relative insulin deficiency, which is associated with increased lipolysis even in non-diabetic patients; stress hyperglycemia may be a marker of glucose regulation in individuals with insulin resistance and developing diabetes.[12] Another reason light to moderate intake reduces the risk by increasing the HDL concentration, whereas heavy drinking increases the risk.

According to Perttu J. Lindsberg and Risto o Roine[13] hyperglycemia was noted in two third (66%) of all ischemic stroke patients. In our study hyperglycemia was noticed in 60% of patients with ischemic stroke. In their study known diabetes and newly diagnosed diabetes contributed one third of cases (33%). In our study the same group contributed 77 %.

Guillermo E Umpierrez et al (2002)[14] did a study confirmed that patients with newly detected hyperglycemia had a significant higher early mortality and a lower functional outcome than patients with a history of diabetes or normoglycemia. Our study of a hundred acute stroke patients had the same results.

Sarah E capes et al[15] analyzed thirty-two similar studies and concluded that hyperglycemic patients had threefold increased early mortality than euglycemic patients. After ischemic stroke admission hyperglycemia was associated with three-fold increased 30-day mortality than euglcemics. The study clearly shows an increased early mortality rate and poor functional recovery in patients with diabetes and stress hyperglycemia when compared to euglycemics. Hence there is an urgent need to confirm the improvement in these patients by normalizing blood sugar. Several trails are now under way to improve the outcome of Stroke by normalizing the blood glucose with human recombinant insulin. Stephan M. Vinychuk et al[16] showed that administration of insulin to patients with hyperglycemia improves functional recovery and vital activity of mild to moderate ischemic stroke patients. However, other clinical benefits of insulin therapy remain to be determined.

CONCLUSION

We concluded that admission day elevated glucose level was a significant predictor of mortality and poor functional outcome after acute stroke. Hence, restoration of normoglycemia as soon as possible should be encouraged. In the interim, we should fare well with adhering to good general stroke management, normalization of body temperature, fluid balance and hemodynamics or we may otherwise risk a favorable outcome even in the patients with normoglycemia.

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