Original Research Article

Blood glucose level on admission as potential indicator of in-hospital mortality in non-diabetic patients presenting with acute stroke

Avtar Singh Dhanju[1], Inderjit Singh[1], Namit Gupta[1]*, Pashaura Singh Sandhu[1], Hargun Singh Sidhu[2]

[1]Department of Medicine, [2]Government Medical College, Amritsar, Punjab, India

*Correspondence:
Dr. Namit Gupta,
E-mail: guptanamit116@gmail.com

ABSTRACT

Background: A stroke or cerebrovascular accident is defined as an abrupt onset of a neurologic deficit that is attributable to a focal vascular cause. Stress hyperglycemia has been defined as hyperglycemia in previously euglycemic patients that corrects once the acute process resolves.
Methods: The present study was conducted in the medicine department, Guru Nanak Dev hospital attached to government medical college, Amritsar from April 2021-December 2021 after taking approval from institutional ethics committee. This was a prospective observational study. A total of 50 non-diabetic patients of acute stroke with age group >18 to <75 of either sex were enrolled in this study. Comparison of mortality was done in hyperglycemic and non hypergylcemic non-diabetic patients on 1st day of admission and up to 10th day during hospital stay.
Results: Mortality percentage on day 1 was higher among those who had high blood glucose levels but there was no significant association between glucose levels and day 1 outcome (survival or death) observed in our study (p=0.078). Mortality percentage on day 10 was higher among those who had high blood glucose levels and there was significant association between glucose levels and day 10 outcome (survival or death) observed in our study (p=0.001). A significant association was observed between glucose levels and overall outcome in our study (p<0.001).
Conclusions: We conclude that even in non-diabetic patients, hyperglycemia on admission is independently associated with a higher risk of in-hospital mortality.

Keywords: Diabetes mellitus, Mortality, Stress hyperglycemia, Stroke

INTRODUCTION

A stroke or cerebrovascular accident is defined as an abrupt onset of a neurologic deficit that is attributable to a focal vascular cause.[1] Stroke is the main cause of disability and mortality among the aging population and about 75% of all cases are ischemic stroke while 15% are hemorrhagic stroke.[2] Hypertension and diabetes are the most common modifiable risk factors among all the risk factors of stroke.[3] Hyperglycemia during the acute stroke phase is associated with poor outcomes in both ischemic and hemorrhagic strokes.[4]

Stress hyperglycemia has been defined as hyperglycemia in previously euglycemic patients that corrects once the acute process resolves. Stress hyperglycemia is different from various forms of diabetes mellitus and is common after suffering an acute illness such as myocardial infarction or stroke, even in the absence of pre-existing diabetes.[5,6]

Hyperglycemia causes direct membrane lipid peroxidation and cell lysis in metabolically challenged tissue by provoking anaerobic metabolism, lactic acidosis and free radical production. Moderately and severely increased blood glucose levels have been found to affect the mitochondrial function in the area of ischemic penumbra.[7]

Hyperglycemia also causes 24% reduction in regional blood flow, reduction in blood circulation to the marginal

ischemic areas and converts ischemic penumbra to infarct.[8]

Objectives

The aim of the study was to determine the admission blood glucose levels in patients of acute stroke and to analyse the impact of admission glucose level on in-hospital mortality in non-diabetic with acute stroke.

METHODS

The present study was conducted in the medicine department of Guru Nanak Dev hospital attached to government medical college, Amritsar from April 2021-December 2021 after taking approval from institutional ethics committee. This was a prospective observational study. A total of 50 non-diabetic patients of acute stroke with age group >18 to <75 of either sex were enrolled in this study. The time from beginning of symptoms to admission in hospital was less than 72 hours and blood glucose level was measured on admission before start of intravenous line. All the non-diabetic patients with blood glucose level ≥140 mg/dL on admission were labelled as stress hyperglycemic. Comparison of mortality was done in hyperglycemic and non hypergylcemic non-diabetic patients on 1st day of admission and up to 10th day during hospital stay.

Inclusion criteria

All non-diabetic patients with HbA1c<5.6% presenting with first acute stroke within 72 hours, confirmed by imaging studies of the head [Computed tomography (CT) or magnetic resonance imaging (MRI)] and age >18 and <75 years of either sex.

Exclusion criteria

Those patients with known diabetes mellitus, patient who had received dextrose containing intravenous fluids before admission, post-surgical or post traumatic (up to one month) and those with pre-existing history of taking drug that elevates blood group glucose levels e.g., corticosteroids, barbiturates, birth control pills (oral contraceptives) and progesterone were excluded from the study.

All the above data was collected, tabulated and was analysed with the use of the Statistical package for the Social Sciences (SPSS Version 23.0) software. Pearson chi square test was applied to calculate the relationship between blood glucose levels and outcome. The values were considered significant when $p<0.05$.

RESULTS

The mean age of the patients included in study was 57.80 years. Out of 50 patients, 16 (32 %) patients were in <50 years age group, 26 (52%) patients were in 51-70 years age

group and 8 (16%) patients were in 71-74 years age group. Females (26) outnumbered males (24), with female: male ratio of 1.08:1. Male (50%) patients had higher incidence of hyperglycemia than females (42.3%) as shown in figure 1, but there was no significant association between gender and hyperglycemia observed in the statistical analysis (p=0.325).
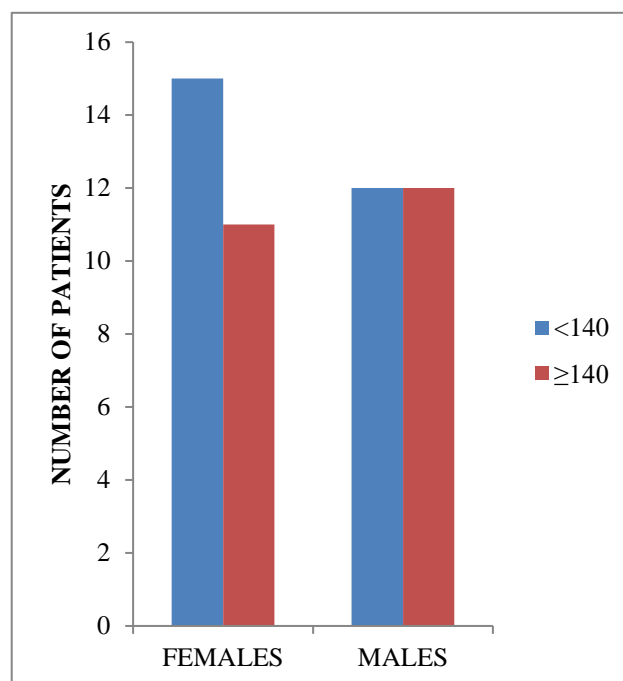

Figure 1: Blood glucose levels and gender.

Prevalence of stress hyperglycemia (>140 mg/dl) in stroke patients in our study was 46% (23 out of 50 patients) as shown in table 1. Stress hyperglycemia was more prevelant among patients with age between 51-70 (57.7%) years but there was no significant association between age and hyperglycemia observed in the statistical analysis (p=0.216).

Table 1: Distribution of patients according to blood glucose levels.

Blood glucose levels (mg/dL)	No. of patients	Percentage (%)
<140	27	54.0
140-190	13	26.0
191-240	5	10.0
>240	5	10.0
Total	50	100
Mean RBS	139.24	

In our study, the incidence of ischemic stroke (68%) was greater than hemorrhagic stroke (32%). MCA (middle cerebral artery) (70%) territory stroke was more common than PCA (posterior cerebral artery) (24%) and ACA (anterior cerebral artery) (6%) territory stroke as showed in Figure 2. The important risk factors were hypertension (36%), smoking (24%) and dyslipidemia (24%).
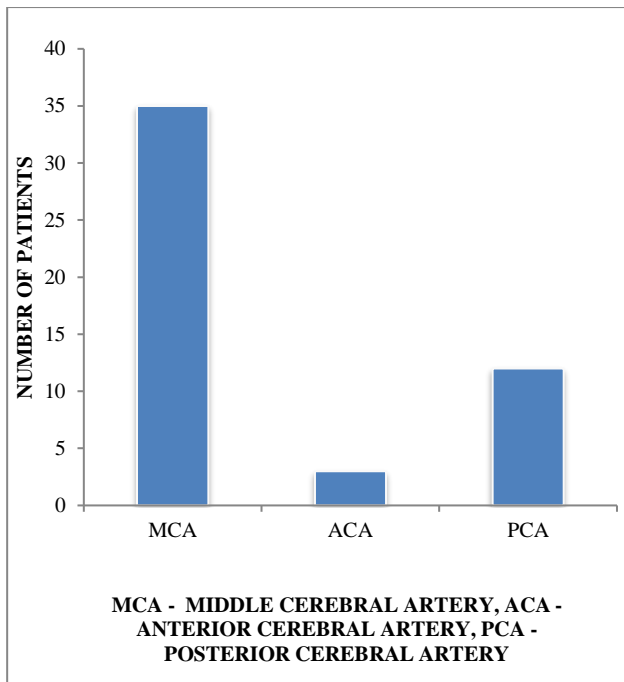
Figure 2: Distribution of patients according to territory involved.

Mortality percentage on day 1 was higher among those who had high blood glucose levels but there was no statistically significant association between glucose levels and day 1 outcome (survival or death) observed in our study (p=0.078) as shown in Figure 3.
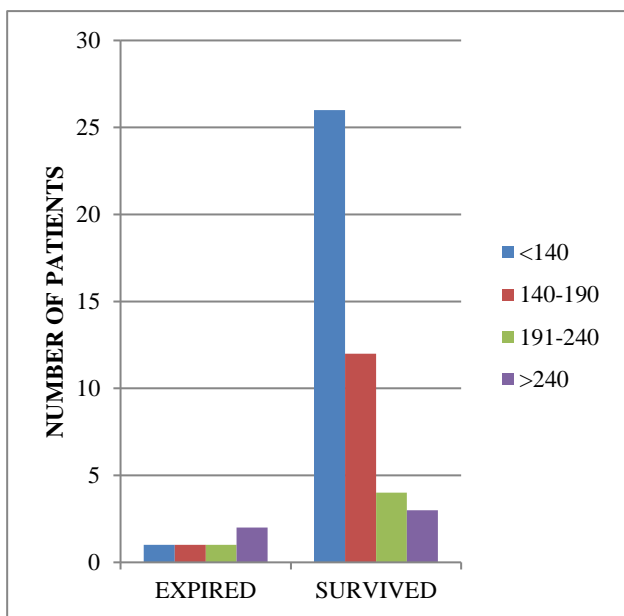

Figure 3: Blood glucose levels and day 1 outcome.

Mortality percentage on day 10 was higher among those who had high blood glucose levels and there was significant association between glucose levels and day 10 outcome (survival or death) observed in our study (p=0.001) as shown in Figure 4.
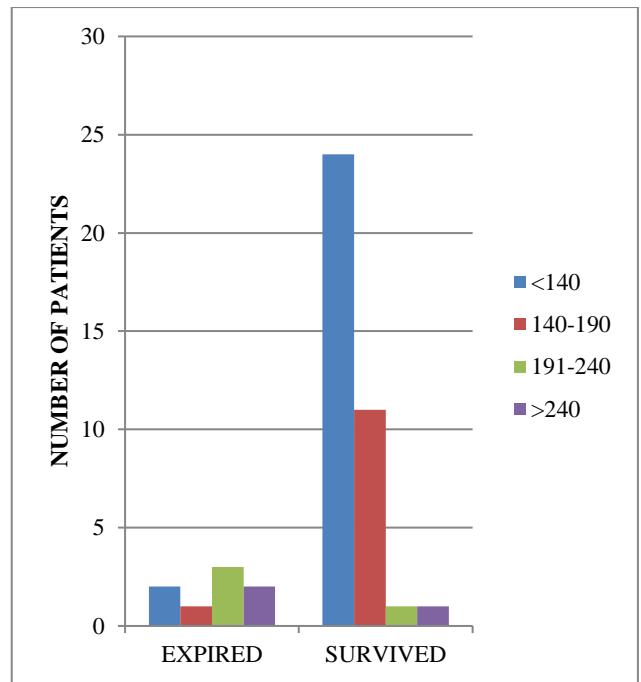

Figure 4: Blood glucose levels and day 10 outcome.

Mortality percentage was higher among who had high blood glucose levels and there was significant association between glucose levels and overall outcome (survival or death) observed in our study (p<0.001) (Figure 5).
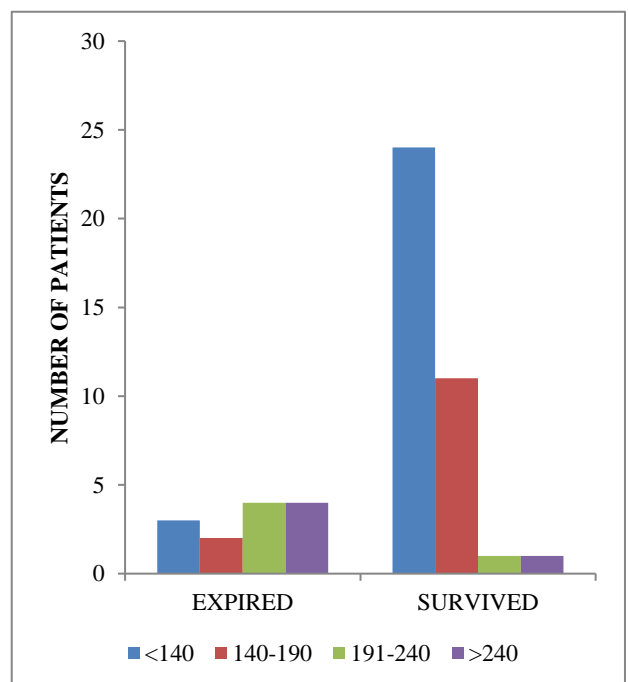

Figure 5: Blood glucose levels and overall outcome (survival vs death).

DISCUSSION

Stress hyperglycemia is a powerful predictor of severity and functional outcome in patients with acute vascular

events such as stroke and various studies found that blood glucose levels at admission can predict the outcome in non-diabetic patients. In this background, this study has tried to analyze the impact of admission glucose level on in-hospital mortality in non-diabetic patients with acute stroke.

In our study the mean age of the study population was 57.8 years, predominantly middle aged (51-70 years) group and most of them were females and MCA territory involvement was present in majority of patients (70%). Similarly, Manickam et al and Abbasi et al also found predominance of MCA territory infarcts in their studies.[9,10] The incidence of ischemic stroke (68%) was higher than hemorrhagic stroke (32%) in our study which is similar to the study done by Shiber et al in which out of 757 patients, 58.1% had ischemic stroke and 41.9% had hemorrhagic stroke.[11]

Systemic hypertension was the most common risk factors observed in the study (36%) and our finding was consistent with studies by Deresse et al and Tirschwell et al they concluded that uncontrolled hypertension was the most important risk factor for stroke both in developing and developed countries.[12,13]

Mean blood glucose level in study group was 139.24 mg/dl. Hyperglycemia (>140 mg/dL) was present in 23 (46%) out of 50 stroke patients and in study done by Marulaiah et al out of the 198 patients, 56.1% study subjects had capillary blood glucose >140 mg/dL on presentation.[14]

In our study, out of 50 patients 5 patients expired on day 1 but on statistical analysis there was no significant association between hyperglycemia and day 1 outcome (survival or death) (p=0.078). Among 45 patients who survived after day 1, 19 patients had blood glucose levels ≥140 mg/dL and among them 6 patients (31.6%) expired before day 10 and there was significant association between high blood glucose levels and day 10 outcome (survival or death) (p=0.038). Overall mortality was higher among patients with hyperglycemia (43.5%) and there was significant association between high blood glucose levels and overall outcome (survival or death) (p<0.001). Our finding is similar to the studies done by Snarska et al, Nardi et al, Zhu et al and Farrkhniaa et al.[15-18] However, studies conducted by Tziomalos and co-workers, Szczudlik et al, Freire et al did not show the similar results.[19-21] Mortality percentage was higher among patients with age between 71-74 years but there was no significant association between age and overall outcome (survival or death) observed in our study (p=0.091). Similar results were seen in a study by Nakayama et al and Gustavo et al.[22,23]

The research, however is subject to few limitations, firstly sample size of our study was small. Secondly, we had no data on history of acute hyperglycemia in prior admissions of the studied population. Thirdly outcomes of the study group were not compared with diabetic patients. Fourthly, we did not sub-classify the stroke according to etiology so did not compare its outcome with stress hyperglycemia.

CONCLUSION

From our study we conclude that even in non-diabetic patients, hyperglycemia on admission is independently associated with a higher risk of in-hospital mortality. Therefore, blood glucose levels should be closely monitored in all patients presenting with acute stroke, regardless of diabetic status.

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