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Association between Admission Hyperglycemia and Outcome in Acute Ischemic Stroke Cases: an Observational Study

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Abstract

Background: *A high proportion of patients suffering an acute stressful condition such as stroke or myocardial infarction may develop hyperglycemia even in the absence of a pre-existing diagnosis of diabetes. The study evaluates the effect of hyperglycemia in the severity and outcome during the acute phase of stroke.*

Methods: *This was a descriptive cross-sectional study. Baseline variables (eg: age, sex, smoking, hypertension, diabetes OHA/insulin) and outcome measures (mortaily, disability) were statistically analysed and compared with a control group 50 patients of acute ischemic stroke without admission hyperglycemia.*

Result: *The base line characteristics of the two patients groups were comparable. The 1st week mortality was 16% in case group and 2% in the control group. The 30 days mortality in the case control grop was 28% and 12% respectively, 58.33% were disabled & dependent in the hyperglycemia group, in comparison to 36.36% subjects in the control group.*

Conclusion: *Admission hyperglycemia seems worsen the outcome and functional disability during the acute phase of Ischemic stroke. Admission glucose level is an important risk factor and should be immediately treated to reduce morbitidity & mortality in acute Ischemic stroke cases.*

Keywords: *Stroke, Hyperglycemia, Cerebral Ischemia, cerebro vascular Injury disability.*

1. INTRODUCTION

Stroke is one of the leading causes of death and disability worldwide and more so in underdeveloped countries like Bangladesh where health support system including rehabilitation is not expectedly available. At least 50% of the neurological disorder in a general hospital is of stroke. World Health Organizasion (WHO) defined Stroke as rapidly developiong clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than vascular origin[1].

Most of the stroke is due to cerebral infarction (80%) the rest is due to haemorrhage. Modifiable risk factors for stroke include hypertension, diabetes, a trial fibrillation, dislipidemia, smoking and alcohol abuse. About one third of patients with acute stroke and no prior diagnosis of diabetes have hyperglycemia during acute phase of stroke[2,9,10] and is associated with worse neurological outcome and increased stroke mortality[11,12,13]. Weather this is an acute stress response or a reflexion of underlying diabeties is controversial[2,14,15,16].

Hyperglycemia has been reported to worsen the tolerance of the brain to is chemia[(3,4)]. Both acute and chronic hyperglycaemia are associated with increased oedema and infarct size[5,7,8,17] and with reduced cerebral blood flow and cerebrovascular reserve[6,18]. The early recognition of disorder of glucose metabolism in stroke patients is important because hyperglycemia during the acute phase worsens the outcome probably by reducing the salvage of penumbral tissue medicated by high lactate level of brain tissue [5,19,20,21].

Hyperglycemia in animal models has been shown to exacerbate acutischemic conditions by stimulating vascular inflammation, increasing blood–brain barrier permeability, impairing cellular metabolism, and promoting tissue acidosis[22,25,26,27]. In models in which the ischemic brain tissue is reperfused, hyperglycemia proves to increase the size of the infarct progressively[28,29], whether in models without reperfusion, it happened to shrink or do nothing[30,31].

Despite of these observations, the relationship between glucose level and outcome after stroke in diabetic and non diabetic patients has not been well characterised and those studies that have examined this relationship have reported confliciting results[6,22,23,24,31]. The present study is carried out to find out the relationship of admission hyperglycemia and its outcome in terms of mortality and morbidity after an acute ischemic stroke.

2. METHODS

Study Design: this study was designed as a descriptive cross- sectional study.

Study setting & population

This study was done among patients admitted in Shaheed Suhrawardy Medical College Hospital between July 2012 to June 2013.Tomographic (CT) diagnosis of ischemic stroke with admission hyperglycemia (RBS>8mmol/L) were included in the study.

Patternts with intracerebral haemorrhage, subarachnoid haemorrhage transient Ischemic attack and with non-stroke cause of focal neurological deficit eg.brain tumour were excluded from the study. Those patients with associated co-morbidity like myocardial in fraction, a trial fibrailation, cancer also not included in the study.

100 patients were selected by purposive type of non probability saemping technique.

A random blood glucose was measured on admission (or within 24 hours of admission) to define admission hyperglycemia (RBS> 8mmol/L). Among them 50 patients who fulfilled the inclusion criteria were selected as case group and another 50 patients with RBS < 8mmol/L were selected for comparison.

Data were collected by taking medical history. Clinical evaluation and laboratory investigations were recorded in a structured data sheet.

The samples under study were examined for assessment and followed up during admission, one week after admission and after one month of discharge from the hospital. Outcome was assessed in terms of fatality and functional recovery after 30 days adjusting age, stroke severity and comorbid conditions parameters used for assessment of stroke severity and outcome were the NIHSS (National Institute of Health stroke scale) and the modified Rankin Scale (MRS)[7]. Data were analyzed by statistical package for social science (SPSS) programme.

3. RESULT

The mean age of the control was 60.10±11.35 years and that of cases was 60.80(±12.37) years. Majority of the patients belonged to the 6th & 7th decade of life. Analysis found no statistically significant difference between the mean age of the control and the cases (P>0.05). This is shown in Table 1

Table1. *Age distribution of study subjects (n= 100, control 50, case 50)*

Age group	Study Subjects		p value
	Case No. (%)	Control No. (%)	
21-30	1(2)	2(4)	
31-40	2(4)	0(0)	
41-50	9(18)	6(12)	
51-60	11 (22)	21 (42)	
61-70	19 (38)	14 (28)	0.769
71-80	7(14)	7(14)	
81-90	1 (2)	0 (0)	
Total	50 (100)	50(100)	
Range	21-90	21-90	
Mean ±SD (years)	60.80±12.37	60.10±11.35	

Chi square test was done, which was not significant (P>0.05)

Out of 50 cases 31 (62%) were male and 19(38%) were female given a male to female ratio of 1.6:1. Among the 50 controls 32 (64%) were male and 18(36%) were gemale giving a male to female ratio of 1.7:1. Analysis revealed that no statistically significant different was found between the sex distribution of the subjects of two groups (P>0.05). This is shown in Table 2

Table2. *Sex distribution of study subjects (n=100, Control 50, case 50)*

Sex	Study Subjects		p value
	Case No. (%)	Control No. (%)	
Male **Female**	31 (62) 19 (38)	32 (64) 18 (36)	
Total	50 (100)	50(100)	
M:F	1.6:1	1.7:1	0.836

Chi square test was done, which was not significant (P>0.05)

Observation shows 30(60%) subjects of case group and 34(68%) subjects of control group have the history of hypertension before ischemic stroke. Analysis revealed no statistically significant difference between the case group and control group regarding previous history of hypertension (P>0.05). This is shown in Table 3

Table3. *Comparison presence of hypertension between case and control group (n=100, Control 50, case 50)*

Study Subjects	Hypertension			p value
	Present No. (%)	Absent No. (%)	No. (%)	
Case Control	32 (60) 34 (64)	20 (40) 16 (32)	50 (100) 50 (100)	0.405

Chi square test was done, which was not significant (P>0.05)

The mean blood glucose level in case group was 11±2.58 mmol/L (Mean ±SD) and that of control group was 5.8±0.72 mmol/L (Mean ±SD). Unpaired "t" test showed that there was significant difference of mean admission blood glucose level between the case and control group (P<0.05). This is shown in Table 4

Table4. *Comparison of blood glucose level between case and control group (n=100, Control 50, case 50)*

Admission RBS	Case group Range (8-20)		Control group Range (4.3 – 7.6)		P value
	Number	Mean ±SD	Number	Mean ±SD	
4-4.9		11±2.58	6	5.8±0.72	0.001
5-5.9			17		
6-6.9			25		
7-8			2		
8-8.9	11				
9-9.9	10				
10-10.9	7				
11-11.9	10				
12-12.9	4				
13-13.9	2				
14-14.9	3				
15-15.9	1				
16-16.9	0				
17-17.9	0				
18-18.9	0				
19-20	2				
Total	50		50		

Unpaired "t" test was done, which was significant (P<0.01)

In the case group 8(16%) subjects died in 1st week in the case group and 1(2%) subjects died in 1st week in control group. Statistical analysis showed that there is significance in mortality during first week between the case and control group (P<0.05). This is shown in Table 5

Table5. *Comparison of mortality in 1st week between case and control group (n=100, Control 50, case 50)*

Study Subjects	Death in 1st week			p value
	Yes No. (%)	No No. (%)	Total	
Case **Control**	8 (16) 1 (2)	42 (84) 49 (98)	50 (100) 50 (100)	0.036
Total	9	91	`100	

Chi square test was done, which was significant (P<0.05)

In another observation 14 (28%) subjects of case group and 6(12%) subjects of control groups died after 30 days of ischemic stroke. Statistical analysios showed that there is significant difference in mortality after 30 dayss between the case and control group (P<0.05). This is shown in Table 6

Table6. *Comparison of mortality in 30 days between case and control group (n=100, Control 50, case 50)*

Study Subjects	Death in 30 days			p value
	Yes No. (%)	No No. (%)	Total	
Case	14(28)	36 (72)	50	
Control	6 (12)	44 (88)	50	0.046
Total	20	80	100	

Chi square test was done, which was significant (P<0.05)

Table 7 shows 21(58.33) subjects of case group and 16 (36.36%) subjects of control group has become dependent after 30 days of ischemic stroke. On the other hand 15 (41.67%) subjects in the case group and 28(63.64%) subjects in the control group become independent after 30 days of the event. Statistical analysis shows significant disability among case group after 30 days of the event (P<0.05).

Table7. *Comparison of disability among survivors after 1st week and 30 days case and control group (n=100)*

Study Subjects	Death in 30 days					p value
	On admission No (%)	After 1st week No. (%)	After 30 days			
			Total Disability	Dependent No. (%)	Independent No (%)	
Case	50 (100)	42 (84%)	36(72%)	21 (58.36)	15 (41.67)	
Control	50 (100)	44 (98%)	44(88%)	16 (36.66)	28 (63.64)	0.049
Total	100	90	80	37	43	

Chi square test was done, which was significant (P<0.05)

Table 8 shows that 8 (40%) subjects who were treated for hyperglycemia became dependent whereas 13(81.25%) subject who were not treated for hyperglycemia became dependent. Statistical analysis shows significant difference between the treated and none treated group of admission hyperglycemia.

Table8. *Comparison of disability among survivors after 30 days between treated and non treated group of hyperglycemia (n=36, treated 20, non treated 16)*

Study Subjects	Disability after 30 days		Total	p value
	Dependent No. (%)	Independent No. (%)	No (%)	
Treated	8 (40)	12 (60)	20 (100)	
Non treated	13 (81.25)	3 (18.75)	16 (100)	0.031
Total	21	15	36	

Chi square test was done, which was significant (P<0.05)

4. DISCUSSION

The present study was carried out to find out the effect of admission hyperglycemia in patients with ischemic stroke irrespective of the cause of hyperglycemia. The study done to find out the assocaition of sociodemographic factors like age, sex, socioeconomic status, personal habit like smoking, family history of stroke and other diseases like hypertension as risk factor in the development of ischemic stroke.

One hundred subjects with ischemic stroke were included in this study of which 50 subjects with ischemic stroke were in the case group with admission hyperglycemia (RBS > 8mmol/L) during admission.

Regarding sex distribution, both the controls and cases were well matched with no significant statistical difference (P>0.05)

The study also showed that 26% of control group and 28% of case group had the family history of stroke. Statistical analysis found no significant difference between the two group regarding family history of stroke (P>0.05).

In the present study, 60% of subjects in the cese group and 68% of subjects in the control group were hypertensive. No statistically singnificant

difference was noted between the two groups (P>0.05).

Hyperglycemia is frequently seen in the acute phase of ischemic stroke affecting up to 20% to 50% of patients at presentation.

In the present study, the mean admission blood glucose level was 11±2.58 mmol/L (mean±SD) in the case group and 5.8±0.72mmol/L (mean±SD) in the control group with a cumulative mean value of 8.4±1.65 mmol/L (mean ±SD). Statistical analysis revealed significant difference between admission blood glucose level in the case and control group (P<0.05). This result coincides with the study done by L. S. Williams et al. in which mean admission blood glucose level in the control group was 98±0.8 mg/dl (5.4±0.04 mmol/L) and that in case group was 224±5.7 mg/dl (12.4±0.32 mmol/L). P value was less than 0.0001 doing chi squared test[5,8].

Admission hyperglycemia was associated with higher mortality rate than was euglycemia. In this study, 16% patients of hyperglycemia group died in the first week in comparison with only 2% in the euglycemic group. Which is statistically significant (P<0.05). Death in 1st week was more in 61-70 years age group (6%) in the cases in comparison to (2%) in the controls of the same age group.

The higher rate of death in the present study may be due to lack of early reperfusion and thrombolytic therapy and inadequate supportice treatment facilities in our hospital set-up.

Regarding mortality after 30 days of ischemic stroke, the hyperglycemic group showed mortality rate 28% in comparison with 12% in the euglycemic group. This indicates a 2.3 fold increase in mortality among the patients with admission hyperglycemia which is also statistically significant (P<0.05). This gets consistent with the similar study of Williams LS et al, too, where the rates were 10% and 5% respectively[5] and with the study of Bruno A. et al, where the odds of good outcome decreased sharply with rises in blood glucose level from 50 to 150 mg/dl[32].

In this study, 58.33% survivors of the case group and 36.3% of the control group were severely disabled after 30 days of ischemic stroke. The remainder 41.67% of patients of the case group and 63.64% of the control group become functionally independent despite some residual disability (P<0.05).

5. Conclusion

The study revealed that there is an association between admission hyperglycemia and poor outcome after acute ischemic stroke. Admission hyperglycemia worsens the outcome and functional disability during the phase of ischemic stroke. The study also suggests that admission glucose level is an important risk factor and should be immediately treated to reduce morbidity and mortality in acute ischemic stroke.

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