Association Between Hyperglycemia and Short-term Outcome in Patients with Ischemic Stroke

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Abstract

Objective: To find association between Hyperglycemia and short-term outcome on patients with ischemic stroke.

Material and Methods: A prospective cohort study was conducted in Neurology Department, Sir Ganga Ram Hospital. Study was conducted for 6 months and it included 60 patients. Fasting blood glucose and 2 hours postprandial blood glucose level and history of Diabetes Mellitus (DM) was recorded on 1st day of admission. HbA1C was measured at baseline. All the patients were assessed at 1st admission day as per the modified Rankin Scale (mRS) and were managed as per policy of the department. Patients were followed up on 30th post-stroke day after discharge. On 30th day, they were assessed by mRS, and short-term poor outcome was recorded in both groups.

Results: Relative risk for poor outcome among exposed patients was 4.20 which means that patients in exposed group had 4.20 times more chances of poor outcome as compared to unexposed patients. Patients in the age group 24-35 and 46-55 years had 15.16 and 11 times higher risk for poor outcome in patients with uncontrolled diabetes. The mean age of patients in exposed and unexposed group was 51.30±14.18 and 43.96±13.12 years.

Conclusion: Uncontrolled diabetes was significantly associated with and poses a high risk for short-term poor outcome in ischemic stroke patients.

Keywords: Ischemic stroke, Uncontrolled, Diabetes mellitus, Short term, Outcome

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Introduction

Stroke is a major cause of death in adult population following cardiac diseases and is responsible for about 10-15% of total deaths each year. Also it contributes as a major cause in long-term morbidity among survivors, as about 35% of the sufferers don't get independent in their future life.[1] According to an estimation by World Health Organization, about 15 million people suffer from stroke per year worldwide.[2]The prevalence of stroke in Pakistan is estimated to be around 21.8% which is more than the rest of the world.[3]Diabetes is a well-well-known risk factor for stroke and various consequences.[4] According to Doi Y and colleagues' Hisayama study, diabetics had twice the risk of stroke as non-diabetics in the overall Japanese population.[5] Additionally, diabetics had a worse outcome after a stroke than non-diabetics. Previous studies have found that diabetics have more residual neurological abnormalities and a lower functional result than non-diabetics. As a result, diabetic patients had greater hospital and long-term mortality rates than non-diabetics, albeit further research could not substantiate these results.[6] In one

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study, the poor outcome rate was higher in patients with uncontrolled Diabetes Mellitus (65.9% in uncontrolled diabetes Mellitus vs 5% in control population p-value 0.001).[7]

Only minimal studies have compared the difference in outcome between controlled, uncontrolled and non-diabetics. With the aim of understanding the impact of blood sugar control on short-term prognosis in ischemic stroke, we designed a study to compare outcomes in patients with controlled, uncontrolled, and non-diabetic conditions.

Material and Methods

The study was carried out at Neurology Department, Sir Ganga Ram Hospital, for six months. The study design was prospective cohort study and non-probability consecutive sampling technique was used. After taken approval from ethical committee No102/ERC/IPH Date 20-3 -2024. A sample size of 60(30 in each group) patients was calculated at 5% level of Significance and 80% power of test and taking expected frequency of poor outcome rate in uncontrolled DM (Diabetes Mellitus) is 65.9% and control group is 5%. Approval from hospital ethical review committee was taken. 60 patients (30 exposed and 30 not exposed) fulfilling the inclusion criteria were enrolled in the study. Informed consent was taken from each participant of the study. In all patients fasting blood glucose and 2 hours postprandial blood glucose level were monitored on 1st day of admission and history of DM was acquired. HbA1C was measured at baseline. All the patients were assessed at 1st admission day as per mRS (modified Rankin Scale). They were managed as per policy of the department and after discharge they were followed up at 30th post-stroke day. At 30th day, they were assessed by mRS and short term poor outcome was recorded in both groups. All the collected data was transferred to SPSS version 20 and analyzed accordingly. Frequency and percentages were calculated for qualitative variable like gender. Mean and standard deviation were determined for all quantitative variables like Age and scores in all groups (using mRS scale). The Relative Risk (RR) was determined in all stroke patients in each group. Stratification was done for age and gender using chi square test and p value <0.05 was selected as significant.

Results

Patients were divided into two groups, based on the presence or absence of diabetes. The group of patients with diabetes was labeled as "exposed group" while the group of patients without diabetes was labeled as "unexposed group". Mean age of patients in exposed and unexposed group was 51.30±14.18 and 43.96±13.12 years. In exposed group 15(50%) patients were male and 15(50%) patients were female. While among unexposed group 11(36.7%) patients were male and 19(63.3%) patients were female. Duration of stroke in exposed and unexposed groups was 7.46±2.54 and 7.53±2.68 hours respectively **(Table 1).** At day 0, the mean mRS score of exposed group was 2.57±1.59 while mRS of

Table 1: *Patient demographics*

	Exposed	Unexposed
Patient Age (Years)		
N	30	30
Mean	51.30	43.96
Standard Deviation	14.18	13.12
Minimum	26	24
Maximum	70	64
Patient Gender		
Male	15(50%)	11(36.7%)
Female	15(50%)	19(63.3%)
Duration of Stroke (Hours)		
N	30	30
Mean	7.46	7.53
Standard Deviation	2.54	2.68
Minimum	4	4
Maximum	12	12

Table 2: *Descriptive statistics for mRS Score at Day 0 and Day 30*

	Exposed	Unexposed	Independent samples t-test	P-value
Day 0				
n	30	30	5.600	0.000001 (Significant)
Mean	2.57	0.73		
Standard Deviation	1.59	0.83		
Minimum	0	0		
Maximum	5	3		
Day 30				
N	30	30	5.173	0.000003 (Significant)
Mean	2.77	0.83		
Standard Deviation	1.76	1.05		
Minimum	0	0		
Maximum	5	4		

unexposed group was 0.73±0.83. At day 30, the mean mRS score of exposed group was 2.77±1.76 while mRS of unexposed group was 0.83±01.05 **(Table-2)**. The difference was significant ($p<0.05$). Short term poor outcome was seen in 21(70%) patients in exposed and in 5(16.7%) patients in unexposed group. Relative risk for poor outcome among exposed patients was 4.20 which mean that patients in exposed group had 4.20 times more chances of poor outcome as compared to unexposed patients. Relative risk for poor outcome for patients in the age group 24-35 and 3-45 years was 15.16 and 2.66 and for patients in the age group 46-55 years and >55 years, relative risk for poor outcome was 11.00 and 1.8 hi respectively. For male patients, relative risk for poor outcome was 4.40 and for female patients it was 3.80 which mean that male and female patients in exposed group had 4.40 and 3.80 times more risk for poor outcome as compared to male and female patients in the unexposed group **(Table-3)**.

Table 3: *Short Term Poor Outcome stratified for age and gender*

	Poor Outcome	Exposed	Un-exposed	RR	CI (95%)	p-value
Age						
24-35	Yes	3(60%)	0(0%)	15.16	0.92-249.63	0.015
	No	2(40%)	12(100%)			
36-45	Yes	4(66.7%)	1(25%)	2.66	0.44-15.95	0.524
	No	2(33.3%)	3(75%)			
46-55	Yes	5(83.3%)	0(0%)	11.00	0.74-163.49	0.015
	No	1(16.7%)	6(100%)			
>55	Yes	9(69.2%)	4(50%)	1.38	0.63-3.02	0.646
	No	4(30.8%)	4(50%)			
Gender						
Male	Yes	12(80%)	2(18.2%)	4.40	1.22-15.80	0.002
	No	3(20%)	9(81.8%)			
Female	Yes	9(60%)	3(15.8%)	3.80	1.24-11.61	0.007
	No	6(40%)	16(84.2%)			

Discussion

IIt is widely established that acute and persistent HG (hyperglycemia) is associated with poor outcomes in patients with severe brain damage.[8,9] However, the lowest safe blood glucose level in neurocritical patients has not yet been determined. The brain is extremely sensitive to variations in blood glucose levels, and the severely damaged brain may be even more susceptible.[8] In this study we assessed the association between uncontrolled DM and short term poor outcome in patients with ischemic stroke. Short-term outcome was determined with the help of mRS assessed at 30th day of stroke. As per this criterion relative risk for poor outcome was 4.20 times higher in patients with diabetes as compared to patients without diabetes. Result of this study is in line with the results of an Egyptian study which showed that poor outcome was significantly higher in hyperglycemia patients as compared to controls. i.e. (Patients with Hyperglycemia: 65.9% vs. Control: 5%). In this study relative risk was calculated for poor outcome however in Egyptian study relative risk was not calculated.

Another study stated an interesting finding that raised ABG (Arterial Blood Gas) in patients without DM hospitalized for acute ischemic stroke is related with increased long-term mortality. Elevated ABG, regardless of DM status, was linked to higher in-hospital mortality and LOS[10] .Previous investigations did not reveal a relationship between short-term mortality and hyperglycemia in people with DM. [10,11,12] One study showed that poor pre-stroke glycemic management is an independent predictor of stroke severity, a good predictor of acute and long-term survival, and a reliable marker of neurological functional prognosis. The HR for DM was 6.15 for 30 days' survival following stroke.[13] Contrary to the findings of this study, which showed a substantial risk of poor outcome at the 30th day, researchers found that higher blood glucose levels >6.1 mmol/l (110 mg/dL) in patients with cerebrovascular accident and no history of DM (Diabetes Mellitus) increased the chance of dying within 30 days by thrice.[15]

A recently published study showed that Cumulative incidence of mortality at 30 day was 4.8% in patients with ACS (acute coronary syndrome).[16] The disparity in death outcomes between patients with and without diabetes could be explained by a number of different factors. Patients with diabetes may have higher cutoff levels for stress hyperglycemia than those without[13].Chronically high blood glucose levels and DM therapy may have a neuroprotective effect. Finally, diabetic individuals are more likely to receive therapy for hyperglycemia.[14] Hyperglycemia in acute ischemic stroke patients is recognized to be an independent predictor of increased infarct size, adverse outcome, and a high fatality rate.[17] The severity of stroke symptoms, as well as the extent of

the infarct, cause an increase in cortisol and norepinephrine production, which is linked to stress.[18] Hyperglycemia during the acute stroke phase is a result of relative insulin insufficiency, which is linked to accelerated lipolysis.[17] Patients with these characteristics are more likely to have hyperglycemia during the acute stroke phase, independent of the existence of DM.[19]

Diabetes is a major modifiable risk factor for stroke, particularly ischemic strokes.[20,21,22] Hyperglycemia during the acute stroke phase is linked to poor outcomes in ischemic and hemorrhagic strokes. It needs to be actively remedied, but the appropriate management strategy is unknown. Aggressive glucose control through lifestyle changes or drugs, as well as the alteration of other associated risk variables (such as blood pressure and dyslipidemia), are crucial steps toward effective stroke prevention.[4] Patients must be educated about complications, have regular checkups, and strictly adhere to treatment.

Conclusion

Results of this study showed that uncontrolled diabetes was significantly associated and poses high risk for short term poor outcome in ischemic stroke patients.

Conflict of Interest: *None*

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Authors Contribution

FS: Conceptualization of Project

NT: Data Collection

NT: Literature Search

KM: Statistical Analysis

MJ: Drafting, Revision

KM: Writing of Manuscript