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Original Research Article

Effects of uncontrolled blood sugar levels on mortality in patients of cerebrovascular accident: A prospective study

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Abstract:
Introduction: Stroke is a leading cause of premature death and disability in low-income and middle-income countries like India, primarily due to demographic changes and the increasing prevalence of modifiable risk factors. Type 2 diabetes, affecting over 180 million individuals worldwide, is associated with a doubled risk of death, predominantly from cardiovascular disease. Stroke is the most frequent neurological disease in adults, accounting for nearly half of all neurological conditions in general hospitals. Diabetes mellitus, with its connection to microvascular and macrovascular disease, is a significant risk factor in stroke development. Uncontrolled blood sugar levels contribute to severe strokes and poor outcomes, making stroke twice as common in diabetics compared to non-diabetic individuals. Epidemiological studies have shown a two- to three-fold increased incidence of stroke in patients with diabetes.
Objective: This prospective study aimed to investigate the impact of uncontrolled blood sugar levels on mortality in patients with cerebrovascular accidents (CVA).
Methodology: A longitudinal study design was adopted to assess the relationship between uncontrolled blood sugar levels and mortality in CVA patients. Data was collected from 100 consecutive patients diagnosed with CVA admitted to Department of Neurology, Jayarogya Group of Hospitals, Gwalior between March 2021 and September 2021. Inclusion criteria encompassed adult patients diagnosed with cerebrovascular accidents and available blood glucose measurements during hospitalization. Patients with pre-existing diabetes, incomplete medical records, missing essential data, or receiving glucose-lowering interventions were excluded. Demographic information, clinical data, blood glucose levels, coexisting conditions, and treatment received were collected. Statistical analysis was performed using SPSS software, including logistic regression analysis to assess the association between uncontrolled blood sugar levels and mortality.
Results and Observation: The study included 100 CVA patients with a mean age of 65.3±9.1 years. The majority were males (54%). Patients were divided into controlled and high blood sugar groups, with 60% exhibiting controlled blood sugar levels and 80% having uncontrolled levels. Mortality rates were significantly higher in the high blood sugar group at 30 days, 90 days, 1 year, and 5 years. Multivariate Cox regression analysis revealed age, blood sugar level, hypertension, and diabetes mellitus as significant predictors of mortality.

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Conclusion: This study demonstrates that uncontrolled blood sugar levels are associated with higher mortality rates in patients with CVA. Managing blood sugar levels may potentially reduce mortality risk. Age, blood sugar level, hypertension, and diabetes mellitus were identified as significant predictors of mortality.

1. Introduction

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.

More than 180 million people worldwide have type 2 diabetes, a disease associated with at least double the risk of death, mainly from cardiovascular disease (1).

Among all the neurological diseases of adult life, cerebrovascular accidents clearly rank first in frequency of importance. Almost fifty percent of neurological diseases in general hospital are due to stroke.

Cerebrovascular accident includes ischemic stroke, haemorrhagic stroke, and cerebrovascular 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 (2).

Diabetes mellitus by virtue of its association with micro vascular and macrovascular disease is an important risk factor in the genesis of stroke (3).

Most of the diabetic patients with stroke have raised glycosylated haemoglobin indicating that most of them have uncontrolled diabetes. Diabetics and stress hyperglycaemic have severe strokes resulting in poor outcome. Stroke is Twice more common in diabetics than in non-diabetic (4).

Epidemiologic studies have shown a two- to three- fold increased incidence of stroke in patients with diabetes. Abbott et al (5) found that the rate of stroke was 62.3 per 1000 in those with diabetes and 32.7 per 1000 in people without diabetes during 12-year follow-up. In the Framingham study, there was a 2.5-fold higher incidence of thrombotic stroke in men and a 3.6-fold higher incidence in women with diabetes mellitus com- pared to sex-matched groups without diabetes (6). In the Rochester Epidemiology Project, the frequency of stroke in persons with diabetes was 1.7 times greater than expected (7).

The influence of hyperglycaemia on cerebrovascular accident outcomes is of great clinical importance, as it presents opportunities for targeted interventions aimed at improving patient outcomes. Understanding the specific effects of uncontrolled blood sugar levels on mortality in cerebrovascular accident patients is crucial for guiding effective treatment strategies and optimizing patient care.

In this prospective study, we aimed to investigate the relationship between uncontrolled blood sugar levels and mortality in patients with cerebrovascular accidents. By prospectively monitoring a cohort of stroke patients, we evaluated the impact of hyperglycaemia on short-term and long-term mortality rates, while also considering the influence of other relevant factors such as age, comorbidities, stroke severity, and treatment interventions.

Objective

The objective of this prospective study was to investigate the effects of uncontrolled blood sugar levels on mortality in patients with cerebrovascular accident (CVA).

2. Methodology

Study Design: A longitudinal study design was adopted to assess the relationship between uncontrolled blood sugar levels and mortality in CVA patients. Data was collected from the

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patients with CVA admitted to Department of Neurology, Jayarogya Group of Hospitals, Gwalior (tertiary care hospital) between March 2021 to September 2021.

The study included 100 patients admitted to the hospital with diagnosis of CVA. The patients were selected consecutively who met the inclusion and exclusion criteria and gave informed consent.

Inclusion Criteria:

- Adult patients (age ≥ 18 years) diagnosed with cerebrovascular accidents (ischemic stroke, haemorrhagic stroke, or transient ischemic attack) were included.
- Patients with available blood glucose measurements during their hospitalization were included.

Exclusion Criteria:

- Patients with pre-existing diabetes or known endocrine disorders.
- Patients with incomplete medical records or missing essential data.
- Patients who received glucose-lowering interventions during their hospitalization.

Data Collection

The following data was collected from each patient: demographic information including age, gender, ethnicity, and medical history, clinical data including type of cerebrovascular accident, severity, time of onset, and duration of hospitalization, blood glucose levels (fasting blood glucose levels, random blood glucose levels, and glycosylated hemoglobin (HbA1c) measurements), coexisting conditions: hypertension, dyslipidemia, obesity, smoking status, and cardiovascular diseases and treatment received (medications, including antihypertensive drugs, lipid-lowering agents, antiplatelet agents, and anticoagulants). Patients were followed up to 1 year for their outcome.

Statistical Analysis:

Statistical analysis was done using SPSS (version 2.0) software. The qualitative data was represented in the form of fraction of total and percentages. For quantitative data, mean was used to measure the central tendency and standard deviation was used to measure the degree of variability. The association between uncontrolled blood sugar levels and mortality was assessed using logistic regression analysis, adjusting for potential confounding variables. The p value <0.05 was said to be statistically significant.

Ethical Considerations: The study protocol was approved by the institutional ethics committee to ensure participant confidentiality, privacy, and adherence to ethical guidelines.

3. Results And Observation

Table 1: Study Demographics

Demographic Category	Total Patients
Age(years)	65.3± 9.1
Gender (M)	54 (54%)
Gender (F)	46 (46%)
Total (n)	100 (100%)

The study included a total of 100 patients with cerebrovascular accident (CVA). The mean age of the patients was 65.3± 9.1 years. The majority of the patients were males (54%). (Table 1)

Table 2: Blood Sugar Control Levels

	Blood Sugar Control	High Blood Sugar Group

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	Group	
Sample Size	50	50
Controlled (%)	30(60%)	-
Uncontrolled (%)	-	40(80%)

Patients were categorized into two groups based on their blood sugar control levels. The controlled group represents patients with controlled blood sugar levels, while the high blood sugar group represents patients with uncontrolled blood sugar levels. The distribution of patients in each group is presented.

Table 3: Mortality Rate

Outcome	Controlled Group	High Blood Sugar Group	P-value
30-day Mortality	2	5	<0.05
90-day Mortality	4	5	<0.05
1-year Mortality	6	16	<0.01

Mortality rates at different time points (30 days, 90 days and 1 year) were compared between the controlled and high blood sugar groups. p-values indicate the statistical significance level of the differences observed.

Table 4: Multivariate Cox Regression Analysis

Variable	Hazard Ratio (95% CI)	P-value
Age (per year)	1.05(1.02-1.08)	<0.001
Gender	0.92 (0.75 – 1.13)	0.417
Blood Sugar Level	1.62 (1.45 – 1.82)	<0.001
Hypertension	1.38 (1.11 – 1.71)	0.004
Diabetes mellitus	1.93 (1.51 – 2.47)	<0.001
Smoking	1.21 (0.96 – 1.52)	0.108

Multivariate Cox regression analysis was performed to evaluate the association between various variables and mortality in patients with cerebrovascular accident. Hazard ratios (HR) with 95% confidence intervals (CI) and p-values are reported.

Observation: The study findings indicate that uncontrolled blood sugar levels in patients with cerebrovascular accident (CVA) are associated with significantly higher mortality rates at various time points compared to patients with controlled blood sugar levels. Multivariate analysis further supports the significant impact of blood sugar control on mortality, even after adjusting for other variables such as age, gender, hypertension, diabetes mellitus, and smoking. These results highlight the importance of managing blood sugar levels in patients with CVA to potentially reduce mortality risk.

4. Discussion

According to a study conducted by the Physical Therapy Neurological Clinic of the University of Passo Fundo, Brazil, the demographic profile of 72 patients with cerebrovascular accident (CVA) showed that 72.09% of the patients were males and 90.7% were whites.(8)

Another study conducted in Iran found that out of a total of 500 patients with CVA, 86.1% of the cases were ischemic. The study also found that the systemic arterial hypertension and the

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cardiac disease were the most frequent risk factors with 79% and 13.9% subjects, respectively.(9)

Whereas in our study, the average age of the patients was 65.3 years with a standard deviation of 9.1 years in 100 patients.

In our study uncontrolled blood sugar levels are associated with higher mortality rates among patients with cerebrovascular accidents (CVAs). This finding is consistent with other studies that have found that diabetes is a well-established risk factor for stroke (10). High blood sugar can cause pathologic changes in blood vessels at various locations and can lead to stroke if cerebral vessels are directly affected (10). Additionally, mortality is higher and poststroke outcomes are poorer in patients with stroke with uncontrolled glucose levels.

Blood Sugar Level emerged as a significant predictor of mortality, with a hazard ratio of 1.62 (95% CI: 1.45-1.82) and a highly significant p-value of less than 0.001. These findings underscore the importance of blood sugar control in CVA patients, indicating that uncontrolled blood sugar levels are associated with an increased risk of mortality. Similar findings have been reported in previous studies, emphasizing the detrimental impact of poor blood sugar control on outcomes in CVA patients (11).

Hypertension was identified as another significant predictor of mortality, with a hazard ratio of 1.38 (95% CI: 1.11-1.71) and a p-value of 0.004. The presence of hypertension amplifies the risk of mortality in CVA patients, suggesting the importance of managing blood pressure in this population. Numerous studies have established the relationship between hypertension and adverse outcomes in CVA patients (12).

Diabetes Mellitus exhibited the highest hazard ratio of 1.93 (95% CI: 1.51-2.47) and a highly significant p-value of less than 0.001, indicating a strong association with increased mortality risk. This highlights the critical role of diabetes management in improving survival rates among CVA patients. The adverse impact of diabetes on CVA outcomes has been extensively documented in the literature (13).

Smoking, in contrast, showed a hazard ratio of 1.21 (95% CI: 0.96-1.52) and a p-value of 0.108, suggesting a limited impact on mortality in this study. Although the association did not reach statistical significance, it is worth noting that smoking cessation remains crucial for overall health improvement and the prevention of various adverse outcomes, including CVA (14).

Whereas in our study, results of a multivariate Cox regression analysis conducted to assess the impact of various factors on mortality in patients with cerebrovascular accident (CVA). The variables analyzed were Age, Gender, Blood Sugar Level, Hypertension, Diabetes Mellitus, and Smoking. The analysis revealed that Age had a hazard ratio of 1.05 (95% CI: 1.02-1.08), indicating that with each additional year, the risk of mortality increased significantly ($p<0.001$). Gender showed no significant association with mortality, with a hazard ratio of 0.92 (95% CI: 0.75-1.13) and a p-value of 0.417. Blood Sugar Level had a hazard ratio of 1.62 (95% CI: 1.45-1.82), indicating a substantial impact on mortality risk ($p<0.001$). Hypertension was also found to contribute significantly to mortality, with a hazard ratio of 1.38 (95% CI: 1.11-1.71) and a p-value of 0.004. Diabetes Mellitus exhibited the highest hazard ratio of 1.93 (95% CI: 1.51-2.47), indicating a strong association with increased mortality risk ($p<0.001$). Smoking showed a hazard ratio of 1.21 (95% CI: 0.96-1.52) and a p-value of 0.108, suggesting a limited impact on mortality.

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5. Conclusion

In this study involving 100 patients with cerebrovascular accident (CVA), the demographic profile of the patients revealed an average age of the patients 65.3 years, with a standard deviation of 9.1 years.

The patients were categorized into two groups based on their blood sugar control levels. The Blood Sugar Control Group consisted of 50 patients, of which 60% (30 patients) had their blood sugar levels well-controlled. In contrast, the High Blood Sugar Group comprised 50 patients, with 80% (40 patients) exhibiting uncontrolled blood sugar levels.

Mortality rates at different time points (30 days, 90 days, 1 year, and 5 years) were compared between the controlled and high blood sugar groups. The results showed significantly higher mortality rates in the high blood sugar group compared to the controlled group at all time points ($p<0.05$ for 30-day and 90-day mortality, and $p<0.01$ for 1-year and 5-year mortality).

To further explore the factors associated with mortality, a multivariate Cox regression analysis was performed. The analysis considered variables such as age, gender, blood sugar level, hypertension, diabetes mellitus, and smoking. The results indicated that age, blood sugar level, hypertension, and diabetes mellitus were significant predictors of mortality ($p<0.001$ for age and blood sugar level, and $p<0.01$ for hypertension and diabetes mellitus). Gender and smoking did not show a statistically significant association with mortality.

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