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Original Article

Prevalence and Pattern of Hyperglycemia in Acute Stroke Patients in a Federal Teaching Hospital in Abakaliki Nigeria

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Abstract

Background: Hyperglycemia is common in patients with acute stroke, and it is increasingly considered an independent risk factor for stroke morbidity and mortality. Admission hyperglycemia in acute stroke patients could result from diabetes mellitus or stress hyperglycemia. Despite the adverse consequences of admission hyperglycemia in acute stroke patients, there has not been any study to demonstrate the burden in Abakaliki, Nigeria. It is against this backdrop that we embarked on this cross-sectional observational hospital-based study to determine the prevalence and pattern of admission hyperglycemia in acute stroke patients in a Federal Teaching Hospital, in Abakaliki, Nigeria from November 2021 to May 2022.

Results: Out of the 210 recruited for the study, 66 (31.4%) had admission hyperglycemia. Elevated glycated hemoglobin and right hemispheric stroke were significantly associated with hyperglycemia.

Conclusion: Admission hyperglycemia is prevalent amongst acute stroke patients in Abakaliki, Nigeria and it is commonly associated with elevated glycated hemoglobin and right hemispheric stroke.

Keywords: Acute stroke; Hyperglycemia; Medical emergency; Nigeria

Introduction

Hyperglycemia is common in patients with acute stroke and occurs in up to 60% of patients overall [1-5] and approximately 12- 53% of acute stroke patients without a prior diagnosis of diabetes [6-9]. It is increasingly considered as an independent predictor of larger infarct size, poor clinical outcome, and higher risk of mortality following stroke [10].

Admission hyperglycemia in acute stroke patients could result from diabetes mellitus or stress Hyperglycemia and Glycated Hemoglobin (HbA1c) level is used to differentiate the two [11].

Diabetes mellitus is a known risk factor for stroke acting through several intermediate vascular disease risk factors, including thrombophilia, endothelial dysfunction, and inflammation [12]. HbA1c level is usually elevated in diabetes due to the long-standing presence of hyperglycemia.

Stress hyperglycemia, also known as Claude-Bernard syndrome is common in critically ill patients like in stroke, and appears to be a marker of disease severity. It results from excessive secretion of cortisol and catecholamine's, characterized by excessive gluconeogenesis, glycogenolysis, and insulin resistance [13-15]. HbA1c level is usually normal in stress hyperglycemia due to the short duration of the hyperglycemia.

Prompt diagnosis and control of hyperglycemia potentially improve the outcome of stroke [16]. Despite the adverse consequences of admitting hyperglycemia to acute stroke patients, there have been few hospital-based studies of the prevalence of admitting hyperglycemia in acute stroke patients in Nigeria. It is against this backdrop that we embarked on this study on the Prevalence and pattern of admitting hyperglycemia in acute stroke patients in a Federal Teaching Hospital in Abakaliki, Nigeria. The results will form part of the database for health planning and development of stroke management protocols.

Methods

This is a cross-sectional observational hospital-based study undertaken at the Medical Emergency unit of the Alex Ekwueme Federal University Teaching Hospital Abakaliki, a tertiary hospital in Abakaliki Nigeria from November 2021 to May 2022 (7 months period). The hospital is a referral hub for Ebonyi and the surrounding states. Acute stroke (1 - 7 days post-stroke) patients usually present to the medical emergency unit from where they are admitted to either the intensive care unit or medical wards depending on the severity. All consecutive acute stroke patients that are 18 years and above, of both gender who had blood samples collected for glucose assay using Accu-check active glucometer before commencement of stroke treatment were included in the study. The case notes of the patients were used to retrieve information on the bio data, clinical characteristics, type, and location of stroke based on neuroimaging, admitting Random Blood Glucose (RBG), Glycated Hemoglobin (HbA1C), and Packed Cell Volume (PCV) test results done at presentation. Hyperglycemia was defined as RBG ≥ 140mg/dl [17]. Abnormal HbA1C was defined as ≥ 6.5% [18]. Stroke was classified as ischemic or hemorrhagic based on the findings of neuroimaging. Altered consciousness was defined as a Glasgow coma score (GCS) of < 15/15. Renal dysfunction was defined as an estimated Glomerular filtration rate (eGFR) of < 60ml/min/1.72m2 using the Modification of Diet in Renal Disease (MDRD)

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calculator [19]. The MDRD calculator uses Serum creatinine value, age, sex, and race in the calculation of renal function. Hypertension was defined as Systolic Blood Pressure (SBP) of ≥ 140mmHg and/or Diastolic Blood Pressure (BDP) of ≥ 90mmHg [20]. Anemia was defined as a packed cell volume (PCV) of <36% [21].

The data were analyzed with Statistical Package for the Social Sciences (SPSS) version 25. The categorical variables were presented as proportions and percentages while numerical variables were presented as means and standard deviations. Chi-square was used for the test of statistical significance with a p-value of <0.05 as significant.

Results

Two hundred and ten (male- 120, female- 90) patients who fulfilled the study criteria were recruited for the study with a sex ratio 4: 3. The age range was 32- 89 years with a mean age of 61.5 ± 12.3 years (male- 62.4 ± 12.2, female- 60.9 ± 11.8). One hundred and twenty (57%) were within the working age of 18 and 64 years old while 90 (43%) were ≥ 65 years. Sixty-six (31.4%) had hyperglycemia with no significant age and sex difference. HbA1C ≥ 6.5% and Right hemispheric stroke were significantly associated with hyperglycemia. The other details are documented in Table 1.

Variables		Hyperglycemia n= 66 (%)	Normoglycemia n= 144 (%)	Total N= 210 (%)	p-value
Sex	Male	41 (19.5)	79 (37.6)	120 (57.1)	0.4027
	Female	25 (11.9)	65 (31.0)	90 (42.9)	
Age range (years)	18- 64	37 (17.6)	83 (39.5)	120 (57.1)	0.9486
	≥ 65	29 (13.8)	61 (29.0)	90 (42.9)	
HbA1C (%)	< 6.5	46 (21.9)	140 (66.7)	186 (88.6)	< 0.0001
	≥ 6.5	20 (9.5)	4 (1.9)	24 (11.4)	
Stroke type	Ischemic	57 (27.1)	110 (52.4)	167 (79.5)	0.1392
	Hemorrhagic	9 (4.3)	34 (16.2)	43 (20.5)	
Stroke location	Right	35 (16.7)	50 (23.8)	85 (40.5)	0.0184
	Left	31 (14.8)	94 (44.8)	125 (59.5)	
Mental status	Conscious	49 (23.3)	91 (43.3)	140 (66.6)	0.1559
	Unconscious	17 (8.1)	53 (25.2)	70 (33.3)	
Blood pressure (mmHg)	< 140/90	21 (10)	29 (13.8)	50 (23.8)	0.0949
	≥ 140/90	45 (21.4)	115 (54.8)	160 (76.2)	
Renal function	Normal	49 (23.3)	110 (52.4)	159 (75.7)	0.8702
	Impaired	17 (8.1)	34 (16.2)	51 (24.3)	
Packed cell volume (%)	≥ 36	38 (18.1)	73 (34.8)	111 (52.9)	0.3834
	< 36	28 (13.3)	71 (33.8)	99 (47.1)	

Table 1: Clinical characteristics.

Discussion

Hyperglycemia is common in patients with acute stroke, and it is increasingly considered as an independent predictor of larger infarct size, poor clinical outcome, and higher risk of mortality following stroke [10].

The reported prevalence of admission hyperglycemia in acute stroke patients in this study is 31.4%. It is like other hospital-based studies which reported 12- 60% [1-9]. The implication is huge considering the poor prognostic effect of hyperglycemia on acute stroke [10,22].

Male patients had a higher prevalence of hyperglycemia than female folks, though not statistically significant. This is similar to the report from a hospital-based study [23]. This is probably because diabetes and hyperglycemia are more prevalent in male folks than their female counterparts due to the protective role of female sex hormones [24].

Those in the working age group had a higher prevalence of hyperglycemia, though not statistically significant. A similar finding had been reported in the past [23]. This could result from blood glucose lowering effects of complications of diabetes like nephropathy which is more prevalent in older individuals. This finding portends great danger as the young and productive population are at risk of worse outcome following an acute stroke due to poor prognostic effects of hyperglycemia.

Hyperglycemia had a statistically significant association with elevated HbA1C level. This is expected as HbA1C is a marker of hyperglycemia and has been recommended as a tool for the diagnosis of diabetes mellitus [18]. HbA1c is the gold standard for monitoring glycemic control in patients with diabetes mellitus and predicts the level of control over the last 8 to 12 weeks [25]. For the diagnosis of diabetes, HbA1c showed poor sensitivity and very high specificity in several studies which suggests that it should be used mainly for monitoring glycemic control, rather than for the diagnosis of diabetes [26-29].

Hyperglycemia was more prevalent in acute ischemic stroke than hemorrhagic stroke in this study, though not statistically significant. This is like the report of other studies [10,30]. This could have resulted from the fact that diabetes and its complications are all independent risk factors for ischemic stroke [31,32]. Furthermore, hyperglycemia also occurs in non-diabetic patients because of the acute stress responses involving the activation of the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system in reaction to extensive brain injury from ischemic stroke [33].

Left hemispheric stroke was noted to be more prevalent than right hemispheric counterpart. This is like the report of Hedna, et al [34,35]. This hemispheric difference in frequency is due mainly to the higher incidence of left hemispheric large vessel strokes in the middle cerebral artery distribution [34]. The above is supported by intima-media complex variation and velocity differences in the left carotid artery accounting for greater stroke incidence in the left hemisphere [36].

The study showed that hyperglycemia was statistically more prevalent in patients that have right hemispheric stroke. There has not been any report on the difference in the prevalence of hyperglycemia between cerebral hemispheric strokes. The cause of the preponderance of hyperglycemia in patients with right hemispheric stroke may not be very clear in this study, but it could relate to the small sample size in the study. This finding should stimulate large-scale multi-center collaborative study to explore the veracity of the above finding.

Hyperglycemia was reportedly more prevalent in patients with normal mental status. This finding may be related to the fact that hyperglycemia was also more prevalent in ischemic stroke which usually present with preserved mental status [37]. Furthermore, the patients that have normal mental status may have taken food with a high glycemic index as a first aid measure for the acute stroke symptoms.

Hyperglycemia was more prevalent in patients with hypertension, though not statistically significant. This is like another hospital-based study [11]. The above finding could result from the fact that hypertension and hyperglycemia are components of metabolic syndrome [38]. Furthermore, both hypertension and hyperglycemia are risk factors for stroke [39].

Hyperglycemia was not associated with renal impairment and anemia. This is unexpected as renal impairment is reportedly associated with hypoglycemia from multi-factorial reasons which include but are not limited to deficiency of precursors of gluconeogenesis, that is, alanine, impaired glycogenolysis, diminished renal gluconeogenesis and impaired renal insulin degradation and clearance, poor nutrition, and, in a few cases, deficiency in an immediate counter regulatory hormone such as catecholamine and glucagon [40]. The explanation for the above finding is that majority of the patients with impaired renal function had mild type. The same explanation goes for anemia as renal dysfunction is mild in the majority of the patients.

Conclusion

Hyperglycemia is highly prevalent amongst acute stroke patients, and it's associated with elevated HbA1C and right hemispheric stroke.

There is a need for prompt screening of all acute stroke patients for hyperglycemia and then manage accordingly as it portends a poor prognosis. There is also a need for large multi-center collaborative studies to elucidate the association of hyperglycemia with right hemispheric stroke type.

Competing Interests

The authors declare that they have no competing interests.

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Author's Contribution

COE conceived the study; COE and FCO were involved in the design of the study, acquisition, analysis, and interpretation of data; COE drafted the work and revised it; COE and FCO approved the submitted version (and any substantially modified version that involves the author's contribution to the study) and have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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