Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i6.1813
*Biol. Clin. Sci. Res. J., Volume 6(6), **2025**: 1813*
Original Research Article

Hyperglycemia in Patients of Acute Ischemic Stroke Presenting to Mardan Medical Complex, Mardan

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(Received, 24th November 2024, Accepted 22nd June 2025, Published 30th June 2025)

Abstract: *Hyperglycemia is a frequent metabolic disturbance in patients with acute ischemic stroke and is associated with poor neurological outcomes. Early identification and management of elevated blood glucose levels may improve clinical outcomes, yet its prevalence remains underreported in many regions of Pakistan.* ***Objective:*** *To determine the frequency of hyperglycemia in patients of acute ischemic stroke presenting to Mardan medical complex.* ***Methodology:*** *We carried out a cross-sectional study which was conducted at the Department of Medicine, Mardan Medical Complex from 19-10-2022 to 19-04-2023. Two hundred and twenty four patients having age 25–70 years diagnosed with acute ischemic stroke via radiological assessment were enrolled. We determined the frequency of hyperglycemia in these patients. Hyperglycemia was defined as capillary blood glucose (CBG) >140 mg/dL.* ***Results:*** *Mean age was 52.48±13.08 years. There were 125 (55.8%) male and 99 (44.2%) female patients. Hyperglycemia was present in 56.1% patients. Stratified analysis revealed notable associations of hyperglycemia with hypertension (P = 0.001) and BMI (P = 0.001).* ***Conclusion:*** *Frequency of hyperglycemia in patients of acute ischemic stroke in our study was 47.3%.*

Keywords: Hyperglycemia, acute ischemic stroke, CBG, hypertension

[***How to Cite:*** Riaz K, Abbas M, Noman M, kour K, Khan WA, Rahman F. Hyperglycemia in patients of acute ischemic stroke presenting to mardan medical complex, mardan. *Biol. Clin. Sci. Res. J.*, **2025;** 6(6): 117-119. doi: https://doi.org/10.54112/bcsrj.v6i6.1813

Introduction

Stroke ranks as second leading factor in death globally, following ischemic heart disease (1). Brain hypoperfusion that results from large vessel occlusion frequently leads to irreversible brain tissue death, as affected area experiences insufficient blood supply leading up in core infarction. The core is encircled by penumbra, a region of tissue in brain that suffers from reduced blood flow but can be preserved via timely restoration of circulation (1-3).

It reported that more than 13.7 million stroke attacks occur every year, with 60% of these instances involving individuals under age of 70 (4). The average lifetime likelihood of experiencing a stroke among people aged 25 and greater is 24.9% (4). Every year, over 2.7 million individuals fall victim to ischaemic stroke attacks (4). Damage to brain can occur caused by a blockage or the rupture of cerebral artery. Acute ischaemic stroke (AIS) embodies the most prevalent type which includes around 85% of instances [4]. Occlusions of internal carotid artery, M1 as well as M2 segment of middle cerebral artery, as well as vertebrobasilar arteries, known to as large vessel occlusions, make up 29% of AIS cases (5, 6).

Hyperglycemia is a widespread comorbidity within patients who have experienced ischemic stroke, linked to progression of brain infarcts, occurrence of hemorrhagic transformation, as well as deteriorated neurological outcomes (7, 8). Factors that result in hyperglycemia encompass reduced insulin secretion, lowered glucose utilization as well as heightened glucose production. Glucose homeostasis symbolizes a delicate equilibrium between production of glucose in liver and absorption and utilization of glucose by peripheral tissues. Insulin serves as main regulator for glucose homeostasis (9, 10).

A study on stroke have identified thromboinflammation as a crucial factor in brain damage caused by ischemic stroke (11). Hyperglycemia intriguingly facilitates thromboinflammation via activation of the endothelium, platelets, as well as neutrophils. In the context of stroke that was demonstrated to hinder after a stroke cerebral blood flow disturb blood–brain barrier, and result in hemorrhagic transformation (12, 13). However, the precise mechanisms that clarify these findings remain only partially understood. .A study recorded the frequency of hyperglycemia 56.1% in cases of AIS (14).

Hyperglycemia is a common metabolic disturbance observed in patients with AIS regardless of pre-existing diabetes status and is related with poorer neurological outcomes as well as increased mortality. Despite its high prevalence, pathophysiological role of hyperglycemia in stroke progression along with recovery remains inadequately understood and optimal glucose management strategies in acute phase are still debated. This study aims to evaluate the frequency of hyperglycemia in AIS providing evidence to inform clinical decision-making as well as potential therapeutic interventions.

Methodology

The cross sectional study was conducted at the Department of Medicine, Mardan Medical Complex, Mardan from 19-10-2022 to 19-04-2023. We initiated the study after obtaining ethical clearance from our institute.

We determined the sample of 224 patients using previously reported frequency of hyperglycemia in AIS patients 56.1% with 95% confidence level and 6.5% absolute precision. Non-probability consecutive sampling was used to enroll patients.

Patients included males and females having age 25 and 70 years. Patients were diagnosed with acute ischemic stroke through radiological examinations. Patients with chronic kidney disease, pre-existing diabetes mellitus or those who were pregnant were not included.

Data collection commenced after each patients provided their consent to participate in the study. Demographic details including age, gender, and socioeconomic background along with hypertension was recorded. Hyperglycemia was diagnosed using capillary blood glucose (CBG) monitoring with a threshold of >140 mg/dL. All measurements were supervised by an experienced healthcare practitioner with a minimum of five years of post-fellowship experience. Data were recorded on a pre-designed proforma.

SPSS version 23 was employed. Age, weight, BMI and height were evaluated using mean and standard deviation. Gender, socioeconomic

status, hypertension and hyperglycemia were presented as frequencies and percentages. We stratified hyperglycemia with age, BMI, socioeconomics background and hypertension. Post-stratification analysis involved the chi-square test with a p-value of ≤0.05 considered statistically significant.

Results

Mean age of our patients was 52.48±13.08 years. Their mean body mass index (BMI) was 26.34±1.38 kg/m². Among the patients there were 125 (55.8%) male and 99 (44.2%) were female patients. Hypertension was present in 77 (34.4%) patients (Table 1).

Hyperglycemia was observed in 106 (47.3%) patients while 118 (52.7%) had normal glucose levels (Table 2). Age distribution showed that hyperglycemia was present in 24 (22.6%) patients having age 25–40 years, thirty one (29.2%) aged 41–55 years and 51 (48.1%) had age 56–70 years with no notable difference (p=0.97). However BMI was notably associated with hyperglycemia as 93 (87.7%) patients with hyperglycemia had a BMI >25 kg/m² (p=0.001). Gender did not show a notable association with hyperglycemia (p=0.30). Hypertension was notably associated with hyperglycemia, there were 48 (45.3%) patients of hypertension with hyperglycemia (p=0.001). Socioeconomic status did not influence hyperglycemia (p=0.86) (Table 3).

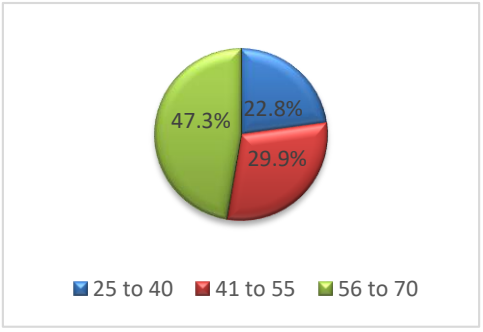

Figure 1: Age distribution of the patients (Years)

Table 1 Demographics of the patients

Demographics		N	%
Gender	Male	125	55.8%
	Female	99	44.2%
Socioeconomic background	Poor	53	23.7%
	Middle class	131	58.5%
	Higher class	40	17.9%
Hypertension	Yes	77	34.4%
	No	147	65.6%

Table 2: Frequency of hyperglycemia

Hyperglycemia	N	%
Yes	106	47.3%
No	118	52.7%

Table 3: Association of hyperglycemia with demographics

Demographics		Hyperglycemia				P value
		Yes		No		
		N	%	N	%	
Age distribution (Years)	25 to 40	24	22.6%	27	22.9%	0.97
	41 to 55	31	29.2%	36	30.5%	
	56 to 70	51	48.1%	55	46.6%	
BMI (Kg/m2)	18 to 25	13	12.3%	36	30.5%	0.001
	> 25	93	87.7%	82	69.5%	
Gender	Male	63	59.4%	62	52.5%	0.30
	Female	43	40.6%	56	47.5%	
Hypertension	Yes	48	45.3%	29	24.6%	0.001
	No	58	54.7%	89	75.4%	
Socioeconomic background	Poor	24	22.6%	29	24.6%	0.86
	Middle class	64	60.4%	67	56.8%	
	Higher class	18	17.0%	22	18.6%	

Discussion

The findings from our study showed that hyperglycemia was present in 47.3% of acute ischemic stroke (AIS) patients. Marulaiah et al reported that 56.1% patients had hyperglycemia who had AIS (14). Zhang et al had reported a pooled incidence of stress-induced hyperglycemia (SIH) of 24% in AIS patients with regional variations ranging from 21% in Asia to 33% in North America (15). Ali et al documented a hyperglycemia frequency of 27% in a Pakistani cohort of AIS (16).

Hypertension was notably associated with hyperglycemia, with 45.3% of hyperglycemic patients having hypertension (p=0.001). Hyperglycemia exacerbates oxidative stress and endothelial dysfunction mechanisms that also underlie hypertensive vascular damage (17). The coexistence of these conditions may worsen cerebral perfusion and infarct expansion.

Body mass index (BMI) showed a notable association with hyperglycemia as 87.7% of hyperglycemic patients had a BMI >25 kg/m² (p=0.001). This finding underscores obesity as a critical modifiable risk factor. Stress hyperglycemia often overlaps with metabolic syndrome components including obesity (15). The high prevalence of elevated BMI in our cohort may reflect dietary patterns, sedentary lifestyles or genetic predispositions prevalent in the region necessitating targeted public health interventions.

Hyperglycemia rates were higher in the group of 56 to 70 years, which infers that older age correlates with poorer glycemic control. Johnston et al in their research included older participants who were presented with hyperglycemia and AIS, which affirms our findings that increasing age can be a contributing factor for hyperglycemia in AIS (18).

Gender wise we observed that 59.4% males had hyperglycemia while 40.6% females had hyperglycemia, similarly Johnston et al's research presented similar findings in their hyperglycemic AIS patients where around 55.3% were male and 44.8% were female patients (18).

The high hyperglycemia frequency (47.3%) in our study raises clinical concerns as hyperglycemia is independently linked to larger infarct volumes, hemorrhagic transformation and poorer functional outcomes. Hyperglycemia-induced lactate accumulation and blood-brain barrier disruption can exacerbate ischemic injury mechanisms that may be

amplified in populations with high metabolic comorbidities like hypertension and obesity. Johnston et al demonstrated that intensive glucose control did not improve 90-day outcomes suggesting that hyperglycemia's detrimental effects may be mediated through irreversible pathways by the time treatment is initiated (18). This underscores the importance of preventive strategies which could target obesity and hypertension.

Conclusion

We conclude that the frequency of hyperglycemia in patients of acute ischemic stroke in our study was 47.3%, which is alarmingly high. We observed that higher BMI and hypertension were notably associated with hyperglycemia in AIS patients.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-269)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

KR (Postgraduate Resident)
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MA (Associate Professor)
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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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