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Admission hyperglycemia and associated risk factors among patients with acute stroke in intensive care units in Kinshasa, the Democratic Republic of the Congo

Hyperglycémie à l'admission et facteurs associés chez les patients avec Accident Vasculaire Cérébral en phase aiguë dans les soins intensifs à Kinshasa, en République Démocratique du Congo

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Résumé

Contexte et objectif. L'hyperglycémie à l'admission en phase aiguë d'AVC est établie comme délétère sur l'issue. Les données sont néanmoins éparsesen Afique subsaharienne quant à son ampleur et aux facteurs associés. Cette étude a évalué la fréquence et les facteurs associés, chez les patients congolais admis en phase aiguë d'AVC dans 6 USI de Kinshasa. ***Méthodes***. L'étude multicentrique de cohorte prospective a inclus des patients consécutifs admis en phase aiguë d'AVC, entre les 15 juillet 2017 et 15 mars 2018. Le score de Glascow a permis d'apprécier la gravité du tableau à l'admission. Les facteurs de risque indépendant associés à l'hyperglycémie ont été recherchés, à l'aide d'une analyse de régression logistique multivariée. ***Résultats***. De 194 patients inclus (H ; 64%), 74,7% avaient une forme légère à modérée et 59% avaient un AVC hémorragique. Un patient sur 2 avait une hyperglycémie à l'admission. Les prédicteurs indépendants de l'hyperglycémie à l'admission étaient l'âge [a OR 1,98 ; IC 95%, 1,17-3,36), un GCS < 8 (ORa 3,83 ; IC 95% : 1,99-7,35) et le diabète (ORa 9,02 ; IC 95% : 3,38-14,05)]. ***Conclusion***. Plus de la moitié des patients avec AVC en phase aiguë présentent une hyperglycémie à l'admission avec comme principaux facteurs de risque associés, l'âge, la gravité de l'AVC et le diabète connu.

Mots clés : accident vasculaire cérébral, facteurs de risque associés, fréquence, hyperglycémie d'admission, noirs africains

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Summary

***Context and objective*.** Despite being established as a correlate of unfavorable outcome in acute stroke, little is known about the burden and associated risk factors of admission hyperglycemia in acute stroke in sub-Saharan Africa. The present study aimed to assess its frequency and associated risk factors in Congolese patients admitted in Intensive Care Units (ICUs) in the acute phase of stroke. ***Methods*.** A multicenter (6 ICUs) prospective cohort study including consecutive patients with acute stroke was undertaken from July 15th, 2017 to March 15th, 2018.The Glasgow Coma Scale helped to determine the severety of the disease at admission. Stress hyperglycemia was considered for a random blood glucose levels at admission >140 mg/dL in patients without type 2 diabetes mellitus (T2DM**)**. Independent factors associated with admission hyperglycemia were assessed using logistic regression analysis. ***Results*.** Out of 194 patients (mean age 58.7±13.1 years; 64% males, 74.7% light to moderate stroke severity; 59% hemorrhagic stroke) enrolled, admission hyperglycemia was found in 106 (54.6%) of patients (mean age 60.1 ± 14.3 years; 67% men, 67% hypertension) with 77 (72.6%) and 29 (27.4 %) of them having stress and chronic hyperglycemia, respectively. Independent predictors of admission hyperglycemia were age [aOR 1.98; 95%CI 1.17-3.36), GCS < 8 (aOR 3.83; 95% CI 1.99-7.35) and diabetes (aOR 9.02; 95%CI 3.38-14.05). ***Conclusion*.** More than half of critically ill patients exhibit admission hyperglycemia with age, severity of stroke and known diabetes as its main associated risk factors.

Keywords: Admission hyperglycemia, stroke, frequency, associated risk factors, black Africans

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Introduction

Stroke is the second leading cause of death and long-term disability worldwide (1-3). Therefore, the identification and control of stroke-associated risk factors could help reducing the negative impact of stroke on the individual, family and community. Among stroke-associated risk factors, disturbed glucose metabolism remains still a matter of both interest and controversy in its relationship to stroke outcome (3-4). Indeed, the relationship of disturbed glucose metabolism has been reported to be bidirectional. On one hand, people with diabetes have more than double the risk of stroke mainly ischemic one compared to non-diabetics; on the other hand, acute stroke can give rise to abnormalities in glucose metabolism, which can affect the outcome (1-4). Admission hyperglycemia is encountered in more than half of patients with acute stroke, most of whom not having a known history of diabetes (3-5). If admission hyperglycemia in some patients is thought to reflect preexisting but unrecognized diabetes (chronic hyperglycemia), it is more often the result of an acute stress response, typically named stress hyperglycemia (2-5). Admission hyperglycemia is associated with poor outcome, possibly through the exacerbation of both primary and secondary brain injury (1-5). Based on this observation, the importance and potential benefit of tight glycemic control in acute phase of stroke has become the focus of intensive research (5). Unfortunately, findings from the review of clinical trials demonstrated that active glycemic control after stroke failed to show clear benefit (1-4). Furthermore, the controversy still remains on whether raised plasma glucose is independently associated with a poor prognosis in stroke patients. Therefore, to address this issue, the first step is to know the burden of post-stroke hyperglycemia in relation to stroke severity before evaluating the impact of hyperglycemia at presentation on outcome in patients with and without prior diabetes (2-4).

In the Democratic Republic of the Congo (DRC), stroke, with hypertension as the main underlying risk factor, is a common finding in daily clinical practice and associated with increased mortality (6-10). The prognostic significance of admission hyperglycemia during acute phase of stroke has been previously shown in specific groups such as hypertensive patients followed at internal medicine wards at Bonzola Hospital in Mbuji Mayi (7-8) and Kinshasa University Hospital (10), and more recently demonstrated among patients to various ERs or ICUs at Kinshasa (11). We therefore aimed the present analysis to highlight the burden, the types, and the correlates of initial hyperglycemia among stroke patients admitted in ERs or ICUs in Kinshasa, DRC.

Methods

Design, setting, period of study

Cross-sectional analysis of data from patients admitted for acute stroke in ERs or ICUs of 6 hospitals (Kinshasa University Hospital, General Hospital of Kinshasa, Ngaliema Clinics, Mother & Child Monkole Hospital, Biamba Mutombo Hospital and Ngaliema Medical Center) and enrolled in a longitudinal study on the relationship between admission hyperglycemia and acute stroke outcomes. From July 15th, 2017 to March 15th, 2018, all patients presenting to the ERs or ICUs with clinical history suggestive of acute stroke were examined and those fulfilling the inclusion criteria (Age ≥ 18 years, acute stroke confirmed by brain CT scan, blood glucose measured at the time of presentation or admission) were examined and consecutively included in the study after informed consent obtained from either the patient's attendant or the patient themselves.

Parameters of interest and operational definitions

Stroke acute phase was defined as the 10 first days after stroke occurrence. Patients with recurrent stroke and those without measured blood glucose at admission were excluded from

the study. Patients demographic, clinical, detailed history regarding temporal profile of stroke, and history of diabetes (defined as known diabetes or current use of antidiabetic medication), hypertension (defined as known hypertension or current use of antihypertensive medication), dyslipidemia (patients on lipid-lowering drugs), smoking (patient with history of using bidi or cigarette), and alcohol consumption (patient who consumed any form of alcohol on most days of a week) information were collected on pretested forms. A sample of venous blood (5 mL) was obtained from each patient for the measurement of hematological (full blood count) and biochemical (blood urea nitrogen, creatinine, uric acid, and electrolytes) parameters. Admission random blood glucose was measured by enzymatic method (glucose oxidase) using HumaLyzer primus automated analyzer (Human, Germany). Patients were stratified as normoglycemics (Blood glucose ≤ 140 mg/dL) and hyperglycemics (blood glucose >140 mg/d) and patients with hyperglycemia were further subdivided into stress hyperglycemia (patients without known diabetes) and chronic hyperglycemia (patients known diabetes) based on sugar levels (12). Stroke severity at the time of presentation was assessed by using Glasgow Coma Scale (GCS) and poor GCS was defined as values <8.

Statistical analysis

All the statistical analyses were done using SPSS Statistical Software Version 21.0. Factors associated with admission hyperglycemia were evaluated by logistic regression models. The strength of the associations was summarized by calculating odds ratios (OR) and corresponding 95% confidence intervals (CI). Ethical clearance was obtained from the institutional ethics committee of Kinshasa School of Public Health, University of Kinshasa.

Results

Sociodemographic and clinical characteristics of the study population as a whole and according to blood glucose level are depicted in table 1.

Of the 256 patients admitted in the Emergency Room or ICU and eligible to the study, only 194 of them (mean age 58.7 ± 13.7 years; 64% men, 64.9% hypertension) fulfilled the inclusion criteria to the study. Secondary and high school education level as well as not secured financial support were reported by 88.1% and 75.3% of patients, respectively. Systolic (SBP) and diastolic (DBP) blood pressure were on average 168.7 ± 37.5 mmHg and 96.6 ± 23 mmHg, respectively. Admission hyperglycemia was found in 106 (54.6%) patients (mean age 60.1 ± 14.3 years; 67% men, 67% hypertension) with 77 (72.6%) and 29 (27.4%) of them having stress and chronic hyperglycemia, respectively. Compared to patients without admission hyperglycemia, those with admission hyperglycemia had a significantly higher proportion of patients with increased age (55.7 vs 40.9%; p = 0.028), diabetes (27.4 vs 3.4%; p < 0.001) and alcohol consumption (27.3 vs 18.9%; p = 0.029).

Table 2 gives stroke characteristics of the study population as a whole and according to blood glucose level.

The average time between stroke occurrence and patient's presentation to hospital was 29 ± 3.3 hours. In the majority of patients (92.7 %), brain CT scan was performed after 12 hours following stroke occurrence. Ischemic and hemorrhagic stroke subtypes were found in 113 (59.3 %) and 71 (36.7 %) patients with hyperglycemia affecting 30% and 65% of patients, respectively.

Loss of consciousness (73.3 %) was the most frequent symptom at admission with 49 patients (25.3 %) having a GCS < 8 at neurological examination. Compared to patients without hyperglycemia, those with admission hyperglycemia tended to have a higher proportion of individuals with coma; however, the difference was not statistically significant. They had paradoxically a significantly lower

(36.8 vs 11.4%; p< 0.001) proportion of individuals with a GCS <8. The differences observed in other variables of interest between the two subgroups were not statistically significant.

The treatment received by the study group as a whole and according to blood glucose levels are presented in table 2. Antiedematous therapy with mainly Mannitol (88.9%) and antihypertensive therapy with mainly calcium channel blocker (Nicardipine) (84.3%) were the medication more frequently received by stroke patients; mechanical ventilation assistance and insulin were prescribed in 25% and 22.2% of patients, respectively. Apart from insulin therapy, patients with admission hyperglycemia had a higher proportion of individuals receiving antiedematous therapy (43.4 vs 29.5%; p= 0.003), mechanical ventilation assistance (31.1 vs 19.3%; p= 0.043) and catecholamine therapy (22.6 vs 10.2%; p= 0.057) in comparison to those without admission hyperglycemia; however, the differences were statistically significant for only antiedematous and mechanical ventilation assistance.

Biological characteristics of the study population as a whole and according to blood glucose level are given in table 3.

Average levels of blood glucose and serum creatinine in the whole group were 182.4 ± 27.5 mg/dL and 4.1 ± 0.9 mg/dL, respectively. Apart from blood glucose levels, patients with admission hyperglycemia had in average significantly higher chloride levels (104.6 ± 9.9 vs 98.5 ± 8.9 mEq/L; p= 0.043). They tended to have in average lower bicarbonate levels; however, the difference was not statistically significant.

Table 4 summarizes the factors associated with admission hyperglycemia in stroke patients. In univariate analysis, age, patient's financial support, alcohol consumption, GCS and diabetes emerged the main factors significantly associated with admission hyperglycemia. In multivariate analysis, the strength of the association observed in univariate analysis persisted only for age (aOR 1.98 [1.17-3.36]), GCS <8 (aOR 3.83 [1.99-7.35]) and diabetes (aOR 9.02 [3.38-14.05]). The likelihood of having admission hyperglycemia was 2, 4 and 9 times higher in patients with age ≥ 60 years, GCS<8 and diabetes, respectively.

Discussion

The main findings of the present cross-sectional study are as follows. First, half of stroke patients presented with admission hyperglycemia of mainly stress hyperglycemia subtype. Second, patients with admission hyperglycemia received more intensive treatment with, in addition to insulin, anti-edematous therapy, antihypertensive therapy and mechanical ventilation assistance. Older age, low GCS, and diabetes emerged as the main factors strongly and independently associated with admission hyperglycemia.

Admission hyperglycemia with mainly stress hyperglycemia subtype was present in half of patients in the present study. Our finding agrees with that of Marulaiah *et al.* (1) and Baird *et al.* (13) who reported similar frequency of admission hyperglycemia. However, this frequency is higher than that reported by Stead *et al.* (14) and lower than that found by Saxena *et al.* (15) and Braundel *et al.* (16). Stress hyperglycemia was present in nearly 7 patients out of 10 in the present study. This frequency is higher may than that of 36%, 35% and 21.2% reported by Toni *et al.* (17), Melamed *et al.* (18), and Marulaiah *et al.* (1), respectively. The disparity in the frequency of admission hyperglycemia and stress hyperglycemia between studies could be explained by the differences in the study populations, the methodology applied and the criteria used to define admission hyperglycemia. Although up to one-third of acute stroke patients have either diagnosed or undiagnosed diabetes, several studies, like ours, reported that a major proportion of patients have stress hyperglycemia mediated by the release of cortisol and norepinephrine (1,19). In patients with known diabetes, this stress response may be blunted by the fact that preconditioning by chronic elevated blood glucose levels may offset adverse metabolic effects, which may influence

prognosis in non-diabetics (1,5). In addition, some medications frequently prescribed to these patients, such as antihypertensive drugs (renin angiotensin system inhibitors, beta- blockers, central acting agents), confer a protective effect against acute stress response (20-22). In the present study, admission hyperglycemia was found in 65% and 30% of patients with hemorrhagic and ischemic stroke, respectively. Our finding agrees with that of previous studies reporting a difference in the occurrence of admission hyperglycemia with stroke subtype; in this regard, hyperglycemia has been reported to occur in 30–40% of patients with acute ischemic stroke (21, 23) and 43–59% of hemorrhagic stroke patients (24). This difference could be explained by the fact the stress in hemorrhagic stroke is more abrupt than in ischemic one where adaptive mechanisms attempts to counteract the metabolic effects of acute stress-released hormones (cortisol and catecholamines) (15).

Patients with admission hyperglycemia were more aggressively treated than those without hyperglycemia. This finding does translate the link between admission hyperglycemia and stroke severity (25-26). In addition to blood glucose levels, this link could be influenced by initial blood glucose variability and glycemic control (25-26). Indeed, in a study on the association of early neurological deterioration assessed by National Institute of Health Stroke Scale (NIHSS) with initial glycemic variability assessed by the standard deviation of blood glucose (SDBG) values and the mean amplitude of glycemic incursions, Hui *et al.* (25) found that patients with early neurological deterioration had in average significantly higher HbA1c levels (8.30 ± 1.92 vs 7.80 ± 1.93%; p=0.043), increased SDBG (3.42 ± 1.14 vs 2.60 ± 0.96; p<0.001) and increased mean amplitude of glycemic excursions (MAGE) (6.46 ± 2.09 vs 4.59 ± 1.91; p <0.001 < 0.001). They concluded that glycemic variability and hyperglycemia during acute stroke are important predictors of the stroke severity. Patients with admission hyperglycemia had higher chloride and somewhat lower bicarbonate levels in the present study. Higher chloride levels could be explained by the fact that, given the severity of stroke (GCS < 8), the brain cell, in order to maintain its volume in case of brain edema, starts a rapid osmoregulation by extruding potassium and chloride ions with water; this adaptive mechanism could explain the observed higher chloride levels. When this rapid mechanism does not allow maintaining cell volume, low osmoregulation, based on extrusion of organic osmoles-like amino acids (26). Lower bicarbonate levels could be linked to anaerobic metabolism with subsequent production of lactic acid and subsequent use of bicarbonate to neutralize this acid load to maintain blood pH.

Older age, low GCS and previous diagnosis of diabetes emerged as the main independent factors associated with admission hyperglycemia. Older age has been reported to be associated with vascular remodeling and receptor down-regulation that could induce insulin resistance and hyperinsulinemia responsible for sympathetic nervous system and renin angiotensin activation and subsequent disorder of glucose and lipid homeostasis (27-28). Our finding of the association of stroke severity (low GCS) and previous diagnosis of diabetes with admission hyperglycemia is in agreement with that of previous studies reporting stroke severity and prior dysglycemia as the main determinants of acute hyperglycemia (29). In the present study, the odds of admission hyperglycemia were increased nine-fold in patients with previous diagnosis of diabetes and only four-fold in those with severe stroke. This finding does suggest that pre-existing abnormalities of blood glucose levels are the most important predictors of acute hyperglycemia, which is consistent with acute post-stroke hyperglycemia being probably more suited as a marker of underlying insulin resistance than the concept of stress

hyperglycemia related to acute physiological stress (29).

The interpretation of the results of the present study should take into account some limitations. First, the cross-sectional design of the present analysis precludes the establishment of any temporal relationship between variables of interest. Second, the small sample size did not confer much power to statistical tests to identify potential associations between variables of interest. Third, the unique measurement of blood glucose could have underestimated the prevalence of admission hyperglycemia. Indeed, admission hyperglycemia alone does not predict early infarct expansion on brain imaging or poor 3 months outcome whereas more frequent or continuous measurements of glucose do so; thus, glucose levels over the first 48 hours after stroke appear to be the most significant predictor of outcome (27). Fourth, the hospital-based design of the present study did allow the generalization of the study results to all stroke patients.

Conclusion

More than half of critically ill patients exhibit admission hyperglycemia with age, severity of stroke and known diabetes as its main associated risk factors.

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Conflict of interest
No conflict

Author's contribution
JKT collected data, participated in data analysis and reviewed the manuscript.
FBl conceived the study, participated in data analysis and drafted the manuscript.
FPK participated in data analysis and reviewed the manuscript.
JRRM participated in statistical analysis of data and reviewed the manuscript.
EKS participated in statistical analysis of data and reviewed the manuscript.
PZA participated in statistical analysis of data and reviewed the manuscript.
ANN participated in statistical analysis of data and reviewed the manuscript.
FMM reviewed the manuscript.
AIM reviewed the manuscript.
SM reviewed the manuscript.
EBA reviewed the manuscript.
JPMI reviewed the manuscript.
WDM reviewed the manuscript.
PMM revised the manuscript
AMK participated in study conception and revised the manuscript.

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Table 1. Sociodemographic and clinical characteristics of stroke patients as a whole and according to hyperglycemia status

Variables	All n=194	No Hyperglycemia n=88	Hyperglycemia n= 106	p value
Age, years	58.7±13.1	57.0±11.3	60.1±14.3	0.099
				0.028
<60, n (%)	95(49)	52(59.1)	47(44,3)	
≥60, n (%)	99(51)	36(40.9)	59(55,7)	
Gender, n(%)				0.497
Males	129(66)	58(65.9)	71(67.0)	
Females	65(34)	30(34.1)	35(33.0)	
Educational level, n (%)				0.394
None	23(11.9)	12(13.6)	11(10.4)	
Primary/secondary	99(51.0)	39(44.3)	60(54.6)	
High	72(37.1)	37(42.0)	35(33.0)	
Financial support, n (%)				0.028
Patient/family	146(75.3)	60(68.2)	86(81.1)	
Employers/Insurance/public sector	48(24.7)	28(31.8)	20(18.9)	
Diabetes, n (%)	32(16.5)	3(3.4)	27(27.4)	<0.001
Diabetes duration, years	7.7±2.3	6.6±2.3	7.8±2.2	0.680
Type of hyperglycemia, n (%)				
Acute (stress) hyperglycemia	-	-	77(72.6)	
Chronic hyperglycemia	-	-	29(27.4)	
Hypertension, n (%)	126(64.9)	55(62.5)	71(67.0)	0.308
Hypertension duration, years	7.8±2.3	7.1±2.8	8.3±2.6	0.214
Previous stroke, n (%)	38(19.6)	18(20.5)	20(18.9)	0.853
Physically active, n (%)	14(7.2)	8(9,1)	6(5.7)	0.260
Alcohol intake, n (%)	44(22.7)	20(18.9)	24(27.3)	0.029
Smoking, n (%)	16(8.2)	6(6.8)	10(9.4)	0.348
SBP, mmHg	168.1±37.5	164.7±38.5	171.3±36	0.161
DBP, mmHg	96.6±23.0	93.9±23.2	99.2±22.6	0.064
MAP, mmHg	120.4±26.1	117.5±25.9	123.3±26.1	0.079
PP, mmHg	71.5±25.0	70.9±28.3	72.1±21.5	0.687
HR, bpm	92.5±23.9	92.9±23.6	92.1±24.3	0.763

Data are expressed as mean±standard deviation, absolute (n) and relative (%) frequency. Abbreviations: SBP, systolic blood pressure DBP, diastolic blood pressure MAP, mean arterial blood pressure PP, pulse pressure HR, heart rate bpm, beat per minute

Table 2. Stroke characteristics of the study population as a whole and according to hyperglycemia status

Variables	All n=194	No Hyperglycemia n=88	Hyperglycemia n=106	p value
Symptoms at admission, n (%)				
Loss of conscious	146 (75.3)	61(69.3)	85 (80.2)	0.057
Impotence	48 (24.7)	25 (28.4)	23 (21.7)	0.181
Seizures	27 (13.9)	15 (17.0)	12 (11.3)	0.174
Vomiting	6 (3.1)	2 (2.3)	4 (3.8)	0.433
Time Interval event-ICU admission, hour	30.1±3	28.9±3.1	31.1±3.2	0.595
Time interval event-brain CT scan, n (%)				0.450
6-12h	15(7.7)	5(5.7)	10(9.4)	
12-24h	93(47.9)	40(45.5)	53(50.0)	
≥24 h	86(44.3)	43(48.8)	33(31.1)	
Stroke type, n (%)				0.115
Hemorrhagic	71(36.6)	39 (44.3)	32 (30.2)	
Ischemic	115(59.3)	46 (52.3)	69 (65.1)	
Temperature, °C	40.6 ± 3,5	40.7 ± 6.6	40,5 ± 4,9	0.971
Respiratory rate, cpm	23.7 ± 5.8	23.5 ± 5.8	23.9 ± 5.9	0.531
GCS	10.6 ± 3.4	11.5 ±3.0	9.9 ± 3.5	< 0.001
				< 0.001
GCS < 8, n (%)	49(25.3)	10 (11.4)	39 (36.8)	
GCS ≥ 8, n (%)	145(74.7)	78 (88.6)	67 (63.2)	
Sp02, %	90,8±9.6	10.5± 3.5	11.6 ± 2.7	0.183
				0.297
Sp02 <90, n (%)	44 (22.7)	22 (25.0)	22(20.8)	
Sp02 ≥90, n (%)	150 (77.3)	66 (75.0)	84(79.2)	
Pupilla status, n (%)				0.916
Bilateral myosis, n (%)	28(14.4)	13(14.8)	15(14.2)	
Bilateral mydriasis, n (%)	22(11.3)	11(12.5)	11(10.4)	
Motor deficiency, n (%)	120(61.9)	57(64.8)	63(59.4)	0.270
Treatment, n(%)				
CCB (Nicardipine)	113(58.2)	64(72.7)	70(66.0)	0.199
Insulin	43(22.2)	0(0.0)	43(40.6)	0.007
Anti-seizure (Phenobarbital)	71(36.5)	32(36.4)	39(36.8)	0.536
Anti-edematous (Mannitol)	72(37.1)	26(29.5)	46(43.4)	0.003
Catecholamines	33(17.0)	9(10.2)	24(22.6)	0.057
Mechanical ventilation	50(25.7)	17(19.3)	33(31.1)	0.043

Data are expressed as mean ± standard deviation, absolute (n) and relative (%) frequency. Abbreviations: CT, computed tomography °C, Celsius degree GCS, Glasgow coma scale Sp02, peripheral oxygen saturation CCB, calcium channel blocker

Table 3. Biological parameters of stroke patients as a whole and according to hyperglycemia status

Variables	N	All n=194	No Hyperglycemia n=88	Hyperglycemia n=106	p value
Glucose, mg/Dl	194	187.9±15.3	120.0±18.0	244.3±11.4	< 0.001
WBC, /µL	132	10747.4±621.3	9989.5±612.8	11439.4±626.0	0.323
N, %	138	72.2±19.3	68.8±19.8	75.4±18.4	0.659
L, %	132	22.4±15.3	22.8±14.5	22.1±16.0	0.609
Creatinine, mg/dL	150	4.2±0.9	4.2±0.7	4.5±2.9	0.681
eGFR, mL/min/1.73m²	150	70.2±47.5	76.6±49.4	57.0±40.4	0.017
BUN, mg/dL	150	63.6±7.3	64.1±7.7	63.3±7.0	0.067
Uric acid, mg/dL	22	7.3±1.8	8.3±4.9	6.1±1.3	0.989
K+, mEq/L	110	4.2±0.7	4.1±0.8	4.3±0.7	0.183
Na+, mEq/L	89	136.4±22.5	139.2±11.2	133.9±29.0	0.227
HCO3, mEq/L	29	20.8±5.3	22.1±5.1	18.1±5.7	0.074
Cl-, mEq/L	38	101.8±10.4	98.1±9.6	104.7±10.2	0.043
Calcium, mEq/L	36	4.3±3.0	4.0±3.4	4.5±2.9	0.298
Ca++, mEq/L	10	1.5±0.6	1.8±0.8	1.3±0.1	0.136

Data are expressed as mean ± standard deviation, absolute (n) and relative (%) frequency. Abbreviations: WBC, white blood cells; N, neutrophils; L, lymphocytes; eGFR, estimated glomerular filtration rate; K+, potassium; Na+, sodium; HCO3, bicarbonates; Cl-, chloride; Ca++, ionized calcium

Table 4. Factors associated with admission hyperglycemia in the study population in logistic regression analysis

	Univariate		**Multivariate**	
Variables	p value	OR (95% CI)	p value	aOR (95% CI)
Age, years				
< 60 years		1		1
≥ 60 years	0,004	2.07 (1.28-3.41)	0,011	1.98 (1.17-3.36)
Financial support				
Secured		1		1
Not secured	0,038	1.70 (1.98-2.96)	0.148	1.54 (0.86-2.77)
Alcohol consumption				
No		1		1
Yes	0,036	1.88 (1.04-3.37)	0.069	1.78 (0.96-3.30)
GCS				
≥ 8		1		1
< 8	< 0,0001	3.94 (2.09-7.43)	< 0.001	3.83 (1.99-7.35)
Diabetes				
No		1		1
Yes	< 0,0001	10.17 (3.86-12.83)	< 0.001	9.02 (3.38-14.06)

Abbreviations: OR, odds ratio aOR, adjusted odds ratio CI, confidence interval