Clinical profile and outcome of hyperglycaemic emergencies at a rural hospital in southern Nigeria

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Abstract

We have documented the clinical pattern of hyperglycaemic emergencies (HGEs) and predictors of outcome at a tertiary hospital in a rural setting in Nigeria. In a 2-year retrospective review, we identified 88 patients with HGEs. Fifty-four (61%) were females, and mean age was 55 years. Forty-seven (53%) had hyperglycaemic hyperosmolar states (HHS), 34 (39%) had diabetic ketoacidosis (DKA), and 7 (8%) had a mixed type of HGE. The commonest precipitating factor was infection and was seen in 39 (44.3%) patients; 28 (32%) were newly diagnosed with diabetes. The mortality rate overall was 34% and the case fatality rate of DKA, HHS, and mixed-type HGE was 23%, 38%, and 57% respectively. Elevated urea was a predictor of poor outcome; while age, gender, and the presence of chronic diabetes complications were not predictors of outcome. We conclude that the mortality rate in HGEs is high, and that elevated urea is a predictor of poor outcome. Effective diabetes education, prompt recognition of symptoms, and treatment of metabolic derangements in HGEs may reduce morbidity and mortality.

Introduction

Hyperglycaemic emergency (HGE) is a serious acute complication of uncontrolled diabetes associated with metabolic derangement, and can be life threatening.[1] The metabolic derangements results from relative or absolute insulin deficiency and elevated counter- regulatory hormones.[2] HGEs are a continuum of metabolic derangements that differ in rapidity of onset, clinical features, severity of dehydration, and degree of ketosis.[3] Diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS) are the two most common HGEs, while mixed hyperglycaemic state emergencies have features of both DKA and HHS.

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The true incidence of HGEs is difficult to establish. Past population-based studies suggest rates of 4.6–8.0 episodes per 1000 patients with diabetes.[4,5] HGEs accounted for 40% of diabetes-related admissions and contributed to 46% of mortality in a hospital-based study in Lagos, south-western Nigeria.[6] Okoro et al[7] in Ilorin, Nigeria, reported a mortality rate of 22% and 25% for DKA and HHS respectively. Also, an earlier hospital-based study on the common causes of morbidity and mortality among admitted patients with diabetes reported that DKA accounted for 27% of mortality.[8]

Despite challenges in the management of HGEs in our country, there is a paucity of information on the pattern of acute metabolic complications and the factors that influence outcome. Hence, this study was designed to describe the clinical and laboratory scenarios associated with HGEs in our setting in order to suggest measures that may reduce their occurrence and subsequent mortality rates.

Patients and methods

This was a retrospective descriptive study conducted in Irrua Specialist Teaching Hospital, Edo State, Nigeria. The hospital provides tertiary levels of healthcare to Edo State and its environs. It is a public hospital with 371 beds and approximately 11100 admissions annually, of which medical admissions make up approximately 20%. Patients admitted into the wards via the Accident and Emergency Unit and the Medical Out-Patient Clinic with the diagnosis of HGE between April 2013 and March 2015 had their case notes retrieved and reviewed. Data were extracted using a standardised questionnaire that included demographics, clinical features, type and duration of diabetes, systolic blood pressure (BP), diastolic BP, precipitating factors, laboratory investigations (random plasma glucose, serum electrolytes, urea, creatinine, and urinalysis at presentation), and outcome at discharge (alive or dead).

Diabetes ketoacidosis (DKA) referred to plasma glucose levels >13.8 mmol/l and the presence of metabolic acidosis (bicarbonate levels of <18 mmol/l) and/or the presence of significant ketonuria (2+ or more). Hyperosmolar hyperglycaemic state (HHS) referred to plasma glucose levels of >33.3 mmol/l, serum osmolality of >320 mosmol/l and bicarbonate levels of >18 mmol/l with or without the presence of non-significant ketonuria (1+).

Table 1. Clinical characteristics of 88 patients with hyperglycaemic emergencies (HGEs)

Type of HGE	Frequency (n=88)
DKA	34 (39%)
HHS	47 (53%)
Mixed pattern	7 (8%)
Biochemistry	
Hyponatraemia	28 (32%)
Hypernatraemia	10 (11%)
Hypokalaemia	9 (10%)
Hyperkalaemia	20 (23%)
Raised urea	53 (60%)

Abbreviations and biochemical parameters: DKA, diabetic ketoacidosis; HHS, hyperosmolar hyperglycaemic state; hyponatraemia = Na<134 mmol/l; hypernatraemia = Na>145 mmol/l; hypokalaemia = K<3.5 mmol/l; hyperkalaemia = K>5.5 mmol/l; raised urea = urea>8.4 mmol/l.

Table 2. Biochemical parameters in individual types of hyperglycaemic emergencies (HGEs)

Parameter	DKA	HHS	Mixed HGE	Significance
Number	34 (39%)	47 (53%)	7 (8%)	
Sodium (mmol/l)	136±5	138±7	140±9	p NS
Potasium (mmol/l)	4.3±0.8	4.7±0.9	5.5±1.2	p=0.004
Urea (mmol/l)	7.8±4.2	16.0±9.2	16.1±8.4	p=0.001
Osmolality (mosmol/l)	312±14	339±19	328 ±16	p=0.001
Glucose (mmol/l)	25.5± 7.6	34.7± 6.0	34.4 ±4.4	p=0.001

Notes: all values are means±SD; significance is calculated by ANOVA; all parameters are in serum apart from glucose (plasma).

Table 3 Laboratory parameters in patients with hyperglycaemic emergencies (HGEs);: comparison between survivors and those who died

Parameter	Survivors (n=58)	Died (n=30)	Significance
Sodium (mmol/l)	137±6	138±8	p NS
Potassium (mmol/l)	4.5±0.9	4.8±1.0	p NS
Urea (mmol/l)	10.8±6.4	16.7±10.4	p=0.002
Osmolality (mosmol/l)	326±18	335±26	p=0.051
Glucose (mmol/l)	30.6±7.3	32.3±9.1	p NS

Notes: all measurements are in serum except for glucose (plasma); statistics by independent t-test.

Mixed- type hyperglycaemic state referred to plasma glucose levels of >33.3 mmol/l, serum osmolality of >320 mosmol/l with the presence of significant ketonuria (2+ or more). Hypernatraemia and hyponatraemia referred to serum sodium levels of >145 mmol/l and <135 mmol/l respectively. Hyperkalaemia and hypokalaemia referred to serum potassium levels of >5.5 mmol/l and <3.5 mmol/l respectively. Plasma urea levels were considered elevated if ≥8.4mmol/l.

Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 20. The mean±standard deviation (SD) values were calculated for continuous variables. Comparison of means was done using an independent t-test and one-way analysis of variance for continuous data. Chi-square test was used for categorical data. Logistic regression analysis was performed to examine the association of some risk factors for outcomes (precipitants of HGEs, metabolic abnormalities, and osmolality). The level of statistical significance was set at $p<0.05$.

Results

A total of 88 patients with HGE were admitted during the period: 54 (61%) were females. The mean age of the subjects was 55±17 years (range 17–85 years). Males were significantly older than females (60±18 years, p=0.03). Of these patients, 47 (53%) had HHS, 34 (39%) had DKA, and 7 (8%) had a mixed-type HE; 28 (32%) of the patients were newly diagnosed with diabetes. Fever was the commonest presenting symptom (58%). Infection was the commonest precipitant, seen in 39 patients (44%), and common infections were urinary tract infections, community-acquired pneumonia, and diabetic foot ulcers. Other rare precipitants were stroke (8%) and myocardial infarction (3%). Table 1 shows the different types of HGE recorded: 39% had DKA, 53% HHS, and 8% mixed type. The prevalence of abnormalities of serum sodium (Na), potassium (K), and urea is also shown.

Table 2 gives mean (±SD) levels of biochemical parameters in each of the three types of HGE. Levels of urea, osmolality, and glucose were significantly higher in HHS and mixed-type HGEs. Serum potassium was significantly higher in mixed-type HGEs. Table 3 compares biochemical parameters in those who survived (58, i.e. 66%) and those who died (30, i.e. 34%). Serum urea was significantly raised in those who died compared with survivors (16.7±10.4 versus 10.8±6.4 mmol/l; p=0.002). Age, gender, and the presence of chronic diabetic complications were not associated with a fatal outcome.

Acute complications were seen in 12 (13%) patients: 7 (8%) developed acute kidney injury (AKI), 3 (3%) hyperglycaemia, and 2 (2%) cerebral oedema. Chronic diabetic complications were present in 75% of the total group. Overall mortality was 30 patients (34%): 8 (23%) with DKA, 18 (38%) with HHS, and 4 (57%) with a mixed-type HE.

Discussion

HGE remains an important acute metabolic complication of diabetes, especially for those living in developing countries where resources are scarce. In this study, infection was the commonest precipitating factor, in keeping with earlier studies.[9,10] The high infection rate in our study may be due to the large proportion of patients newly diagnosed with diabetes (32%) whose knowledge of infection prevention and control strategies may be low. Also, widespread poverty in Africa has been associated with scarcity of resources in healthcare systems and poor

nutrition.[11] The percentage of newly diagnosed patients in our study was higher than that reported by Ogbera et al[10] in Lagos, Nigeria who documented a lower rate of 15% in patients with HGEs. An earlier study by Edo[12] in southern Nigeria reported a higher percentage: 55% of those presenting with HGEs were previously undiagnosed with diabetes. This finding suggests that many adult Nigerians with diabetes are undiagnosed until they develop complications, with significant morbidity and mortality. Therefore, the need for more public awareness campaigns and screening (especially for those with known risk factors) cannot be overemphasised.

In this study, HHS accounted for 53% of the HGE admissions, while DKA and mixed-type HGEs accounted for 39% and 8% respectively. This pattern is in contrast with earlier studies, which reported DKA as the commonest HGE. This difference may be explained by a higher number with type 1 diabetes in the earlier studies.[10,13]

Presenting random plasma glucose was significantly higher in HHS than DKA patients, similar to a previous report by Anumah and Ohwovoriole.[14] Serum potassium was within normal limits in most patients and this was similar to a previous report by Akinlade et al.[15] In metabolic acidosis and insulin deficiency states, it is expected that the potassium levels will be elevated or within the normal range due to physiological compensation, although it is known that total body stores of potassium are depleted in DKA.[16,17] In our study, elevated urea was seen in two-thirds of patients and was a significant predictor of mortality (p=0.002). Elevated urea is a reflection of the degree of dehydration and potential progression to acute kidney injury (AKI) which can predict a poor prognosis.[13]

Mortality is particularly high in our setting, most probably because of lack of effective and systematic diabetic education, shortage of trained health personnel, and inadequate laboratory support. Also, financial constraints are important since patients and their relatives bear the cost of healthcare services in Nigeria, and many patients present very late with acute complications.

Our study was relatively small, and not all relevant biochemical parameters could be measured. Nevertheless, we have demonstrated significant mortality rates in HGEs, and shown some factors linked to a poor prognosis.

We recommend improved patient and staff education, as well as diabetes-related health promotion campaigns. A national effective health insurance scheme would also facilitate affordable healthcare delivery. Finally, larger (preferably multi-centre) studies on HGEs in Nigeria would be very useful.

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