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ARTICLE

Clinical characteristics of people with diabetic ketoacidosis at a clinic in The Gambia: a retrospective study

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Background: Diabetic ketoacidosis (DKA) remains an important cause of hospitalisation and death in people with diabetes mellitus (DM) living in low- and middle-income countries. The clinical profile of patients with DKA varies, and maybe contributory to the outcomes observed globally. The aim of this study was to describe the clinical characteristics of people with diabetic ketoacidosis (DKA) seen at a clinic in The Gambia during a one-and-a-half-year period.
Methods: This was a retrospective chart review that included people with DM who were seen from June 2017 to December 2018 at the Medical Research Council the Gambia at London School of Hygiene and Tropical Medicine. Biodata, anthropometric and admissions data were extracted for all patients from the electronic medical records system. Data were analysed for differences in clinical and biochemical characteristics on admission for DKA.
Results: In total, 23 out of 103 admissions for people with DM were for a diagnosis of DKA during the study period. Sixteen of those included were females and the mean age of all patients was 35 ± 13years. Two people had type 1 DM and 15 people were categorised as type 2 DM. DM was diagnosed for the first time during admission for DKA for 12 people and 6 people had confirmed sepsis. There were no significant differences in age at diagnosis of DM or biochemical characteristics.
Conclusion: DKA was a common indication for admission for people with DM in the Medical Research Council the Gambia at London School of Hygiene and Tropical Medicine and the majority of patients with DKA had type 2 DM. Further studies are needed to describe DKA in this setting more accurately.

Keywords: diabetes, ketoacidosis, Gambia

Introduction

As the prevalence of diabetes mellitus (DM) increases in low- and middle-income countries, understanding the manifestations and complications become increasingly important. The prevalence of DM is expected to rise to in sub-Saharan countries.[1] DM is responsible for about 10% of hospitalisations due to non-communicable diseases in The Gambia[2] and it is estimated that 3.6% of the annual national health budget is spent on its management.[3] Although there are several classes of DM, the commonest types of DM are type 1 and type 2 DM. Type 1 DM is associated with lean body habitus and usually presents in children and young adults. It results from a deficiency of insulin arising from the destruction of pancreatic beta islet cells responsible for insulin synthesis and secretion. In contrast, type 2 DM typically occurs in older adults who are overweight and is as a result of relative insulin deficiency caused by insulin resistance and increased demand for insulin from extra adipose tissue.

Diabetic ketoacidosis (DKA), an acute complication of DM and a combination of hyperglycaemia, ketosis and acidosis,[4] is commonly associated with type 1 DM. This occurrence is believed to be related to the absolute deficiency of insulin. DKA is not as common with type 2 DM as with type 1 DM[5] as often there is sufficient insulin to prevent ketosis in people with type 2 DM.[6] DKA is a major cause of hospitalisation for patients with DM and in one study in The Gambia it was found to be the major cause of death followed by sepsis from foot infections.[3] Mortality rate from DKA varies from 10% and 30% in low- and middle-income countries[7–11] and < 1% to 4.5% in high-income countries.[12–14] The average cost of care for DKA was estimated to be £2 064 per person in the UK[15] and $26 566 in the USA;[16] there is a paucity of data from low-income countries. Several clinical practice guidelines are available for the management of DKA in hospital settings and they all emphasise the need for glycaemic control with insulin, fluid and electrolyte replacement and treatment of precipitant.

Despite the significance and burden of DM and DKA we found no studies on this from The Gambia. As doctors working in the clinic at the Medical Research Council The Gambia at London School of Hygiene and Tropical Medicine (MRCG@LSHTM), it is our experience that a proportion of patients admitted with DKA do not require insulin treatment in the long term. This study was therefore conducted to describe people with DKA seen at our clinic.

Methods

Study design and study area

This is a retrospective chart review of people with DM seen at the Clinical Services Department (CSD) of the MRCG@LSHTM from 1 June 2017 to 31 December 2018. Located in an urban residential area 13.8 kilometres from Banjul, the capital of The Gambia, the CSD provides health care to adults and children from all over The Gambia. It is a secondary health centre consisting of an outpatient department and inpatient wards for admission of paediatric and medical cases only. Quality of care of patients is maintained using locally adapted guidelines and standard operating procedures.

Study criteria

All individuals with a diagnosis of DKA were included in the study. A diagnosis of diabetic ketoacidosis (DKA) was made if a patient was admitted with a blood glucose of ≥ 11.1 mmo/l or known to have DM, urinary ketones of 2+ (using a dipstick) or more and serum bicarbonate of 18 mmol/l or less.[18–20] Serum ketones and venous pH are not routinely analysed at our centre.

DM was defined as a recorded fasting plasma glucose of ≥ 7 mmol/l or a random plasma glucose of ≥ 11 mmol/l at diagnosis (with symptoms such as weight loss, polydipsia, polyuria and polyphagia),[17] or if the patient was already on glucose-lowering agents.

Data collection

Data were extracted from the electronic medical records system (EMRS) for all patients with an International Classification of Diseases revision 2010 (ICD-10) code for DM (E08-E13) as provisional or final diagnosis, into a Microsoft Excel spreadsheet (Microsoft Corp, Redmond, WA, USA). Details from patients' records were entered into a Microsoft Access database. These details included demographic data, weight, height, date of diagnosis of DM and class of DM. Admissions data included date of admission and admission outcome, diagnoses, presence of fever on admission, presence of ketones on urine dipstick analysis, biochemical profile, white blood cell count, blood culture results and time on insulin in days.

Classification of DM

Classification of DM was made clinically at diagnosis and was based on age at onset and response to oral glucose-lowering drugs (OGLD). People with an ICD10 code for insulin dependent DM (IDDM) and with an age of onset 20 years or younger were considered as type 1 DM. People with an ICD10 code for non-insulin independent DM (NIDDM) or DM and who maintained glycaemic control on OGLD were classified as type 2 DM. Persons who were older than 20 years of age and whose response to OGLD remained poor were categorised as unclassified DM. Glycaemic control was based on clinic fasting plasma glucose measurements and was maintained if the values consistently ranged from 4 to 10 mmol/l.

Data analysis and statistical methods

Data analysis was done using IBM SPSS Statistics for Windows version 20.0 (IBM Corp, Armonk, NY, USA). All patient identifiers were removed from the dataset before analysis. All continuous data were presented as means and standard deviation (SD) (or medians and interquartile range) and categorical variables were presented as proportions. A Kruskal–Wallis test was used to determine the differences between the classes of DM presenting with DKA where continuous variables were not normally distributed. A p-value of < 0.05 was considered as statistically significant.

Ethical consideration

Ethical clearance was obtained from The Gambia Government / MRCG Joint Ethics Committee (SCC1646 v1.1). All participants consented to have their de-identified data used in this study. All information collected remains confidential. All methods were performed in accordance with the Declaration of Helsinki.

Results

There were 639 patient records extracted from the EMRS database with the ICD codes for diabetes mellitus. However, 604 patients had an actual diagnosis of DM. There were 352 (58%) female and 252 (42%) male patients with DM seen at our clinic. Fifteen (3%), 545 (90%) and 44 (7%) had type 1, type 2 and unclassified DM, respectively.

Table 1: Clinical characteristics and admissions outcomes of people with diabetic ketoacidosis (DKA)

Variable	*n* (%)
Admission diagnosis:	
Diabetic ketoacidosis	23(22)
Others	80(78)
Types of DM:	
Type 1	2
Type 2	14
Unclassified	7
New diagnosis of DM at presentation	12
Presence of fever	4
Elevated white cell count on admission (> 10×10^9/l)	12
Positive blood culture result	6
DKA admissions outcome:	
Discharged	19
Referred	1
Died	3

Regarding hospitalisations, there were 103 admissions for persons with DM within the review period. Of 23 admissions for DKA, there were three readmissions for DKA, and none occurred within 30 days of a previous admission for DKA. There were 16 female patients, and the mean age (SD) was 35 (13) years (range 15–65 years). Among those who were not newly diagnosed with DM, eight patients were non-adherent to medications, two patients had heart disease including angina pectoris and one patient had a urinary tract infection. The length of stay in hospital ranged from < 1 to 25 days with a median (interquartile rage) of 8.5 (4.8) days. The clinical characteristics of all people seen with DKA are shown in Table 1. Severe DKA was seen in four patients; two with serum bicarbonate < 5 mmol/l and two with serum potassium < 3.5 mmol/l. Severe DKA was the likely cause of death in one patient while sepsis and heart failure was the possible cause in the two others.

The age and sex distribution and biochemical profile of persons with DKA in relation to type of DM are given in Table 2. There were more females among those with type 2 and unclassified DM. The differences in the biochemical variables and age ($\chi^2 = 4.583$, $p = 0.101$) did not reach statistical significance. Only nine patients had anthropometry done among those with DKA.

Table 2: Age and sex distribution, and laboratory findings according to type of DM

Variable	Type 1	Type 2	Unclassified
Female sex	1	9	6
Age (years)[a]	18 (0)	34 (16)	40 (16)
Bicarbonate (mmol/l)[a]	6 (0)	8 (11)	5 (5)
Potassium (mmol/l)[a]	3.5 (0)	4.8 (0.7)	4.5 (1.8)
Creatinine (μmol/l)[a]	60 (0)	61 (18)	51 (87)
Urea (mmol/l)[a]	7.5 (0)	4.0 (4.3)	4.8 (4.8)

[a]Reported as median and interquartile range.

Discussion

DKA is a common acute complication of DM at our clinic, accounting for about one-fifth of admissions. Few studies report the proportion of admissions due to DKA. One study from Kenya reported that 8% of admissions for DM in their centre were for DKA.[21] The difference in our findings may be related to methodology; their study was a prospective study lasting for nine months.

More than half of the admissions for DKA were for people with type 2 DM in our review. Our findings are comparable to those from South India and Nigeria where a major proportion of patients with DKA had type 2 DM.[7,22] Our findings differ from retrospective studies of DKA admissions in the USA and Switzerland where less than 30% of patients with DKA had type 2 DM.[23–25] Our observations were also in contrast to those from a study done in a rural regional hospital in South Africa among black Africans, where a majority of those admitted with DKA had type 1 DM.[8] It is possible that type 2 DM presents differently in our setting; however, it is also likely that distinguishing between types of DM by clinical features only may have resulted in misclassification. There is a possibility that these persons could be in the 'honeymoon' phase of type 1 DM or may be in an entirely different class of DM. Lastly, the preponderance of type 2 DM in patients with DKA may reflect the greater prevalence of type 2 DM seen at our clinic.

For over half of patients admitted for DKA, this was their first manifestation of DM. This is akin to findings from Kenya.[9] Newly diagnosed DM represented a smaller proportion of patients diagnosed with DKA in studies from Nigeria, India, Tanzania and the USA.[10,22,26,27] A possible explanation for this observation in our study is that patients do not generally seek help unless the illness is severe. Our patients may also have been unaware of the earlier symptoms of DM such as polyuria and polydipsia and so did not seek care sooner. Although about half of patients with DKA had elevated white blood cell counts, only a quarter had confirmed infections. An elevated white blood cell count of $10–15 \times 10^9$/l can occur in DKA but this is attributable to the stress of hyperglycaemia rather than an infection.[28] Leucocytosis is more likely to be caused by an infection if the white blood cell count is $> 25 \times 10^9$/l.[29] This occurred in only one patient in our study despite confirmed sepsis in six patients. C-reactive protein or procalcitonin levels would have been useful tools for confirming the presence of infection; however, the facilities for these are unavailable at our centre.

People with type 2 DM and DKA, referred to as ketosis-prone atypical DM in some literature, are often males.[5,25,30–32] People with type 2 DM and DKA in our study were predominantly female. Although there was a greater proportion of males with type 2 DM and DKA in the study from the USA, this was not statistically significant.[27] Our study findings can be attributed to the sex distribution of people with DM attending our clinic where females were the majority in general.

There were no significant differences in the metabolic characteristics of all our participants with DKA. This finding was similar to those from studies on patients with DKA in the USA.[27] Mean bicarbonate levels seemed higher in patients with type 2 DM in our study. This was comparable to findings in a study among Caucasian patients with DM in Switzerland.[25] Our findings are also comparable to the results of a study done by Ndebele and Naidoo,[8] where bicarbonate levels were significantly higher among people with type 2 DM and DKA. Our case mortality rate for DKA was 13%, which was greater than experienced in Nigeria, Libya and developed countries[12–14,22,33] but comparable to the rates in other low- and middle-income countries.[7–11] Our centre is one of the few secondary health centres where insulin infusion pumps, used to deliver fixed-rate intravenous insulin infusion, are available and where reliable laboratory support is always provided. We have developed guidelines suited to our setting for the management of DKA at our centre and all medical personnel have been trained to adhere to them. These features account for the relatively low mortality rate in a low-income country.

Due to the retrospective design of this study, information such as anthropometric data was incomplete. Accuracy of DM classification could not be ascertained by investigating pancreatic beta islet cell status and presence of autoimmune antibodies against the islet cells as these tests are unavailable. Our findings are limited to urban secondary health centres in The Gambia. The introduction of the EMRS in CSD in 2017 and using routinely collected data from this platform serves as a foundation for further research in our setting.

At our secondary health centre, about a fifth of the admissions for people with DM were for a diagnosis of DKA. The majority of patients with DKA had type 2 DM and were newly diagnosed. Understanding DKA and DM in our setting will require further research.

Disclosure statement – No potential conflict of interest was reported by the authors.

Declarations – Ethics approval and consent to participate: the authors received ethical approval from The Gambia government /MRCG Joint Ethics Committee (SCC 1646 v1.1). All participants consented to have their de-identified data used in this study. All methods were performed in accordance with the Declaration of Helsinki.

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