

Frequency of Complications in Admitted Patients of Diabetic Ketoacidosis

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ABSTRACT

Objective: To determine the frequency of different complications in admitted patients of diabetic ketoacidosis (DKA).

Study Design: A cross-sectional study.

Place and Duration: Diabetic ward of National Institute of Child Health (NICH), Karachi Pakistan from 1st November 2020 to 31st October 2021.

Methodology: A total of 253 children of either gender aged 1 to 15 years admitting with DKA and duration of diabetes mellitus ≥ 3 years were included. All patients were subjected to detailed history and clinical examination for DKA and its complication like hypoglycaemia, hypokalaemia, hyponatraemia, hypocalcaemia, hyperkalaemia.

Results: In a total of 253 children admitted with DKA, 123 (48.6%) were girls and 130 (51.4%) boys. Mean age of patients was 6.11 ± 2.87 years, mean BMI was 20.9 ± 4.7 kg/m², while mean duration of diabetes mellitus was 3.5 ± 1.2 years. Mean plasma glucose was 22.5 ± 6.0 mmol/L (405 ± 108 mg/dl), mean HbA1c $10.2 \pm 2.1\%$ while mean pH was 6.9 ± 0.4 . In a total of 253 patients with DKA, hypoglycemia was noted in 47 (18.6%), hypokalemia 17 (6.7%), hyponatremia 22 (8.7%), hypocalcaemia 11 (4.35%) while hyperkalaemia was observed in 9 (3.56%) patients.

Conclusion: Most of the patients admitted with DKA were aged <10 years who developed complications. Hypoglycemia was the most common complication of DKA while hyponatremia the 2nd most frequent complication observed in DKA patients. Electrolytes should be investigated and managed timely to avoid unwanted outcomes among patients admitted with DKA.

Keywords: Complications, diabetic ketoacidosis, diabetes mellitus, children.

INTRODUCTION

Diabetic ketoacidosis is described as a complex metabolic state of hyperglycemia, ketosis and acidosis.¹ If the absolute or relative deficiency of insulin is not treated properly in type 1 or type 2 diabetes mellitus, it can lead towards DKA.² Since 1970, mortality from DKA has remained 1-2% despite the factor that different types of awareness programmes and lots of research have been conducted.³ DKA is the most common cause of death in children with type-1 diabetes mellitus.^{4,5} DKA also poses a huge economic burden on the medical system.

Ketoacidosis (DKA) and its complication are the life-threatening pediatric metabolic emergency. In the developed countries there is a significant decrease in the death rate of children coming across with DKA and its complication. But in developing countries DKA and its complication is a potent risk factor for death in children even before coming to some medical assistance. In diabetic children aged less than 12 years, cerebral oedema is the main cause of death in 70-80% of the patients.⁶⁻⁹ At the time of admission, hypoglycemia (18.6%), hypokalaemia (6.7%), hyponatraemia (8.7%), hypocalcaemia (4.4%) and hyperkalaemia (3.6%) are some of the most frequently observed complications among children with DKA.⁵ It is necessary to manage the levels of potassium very carefully while treating DKA as hypokalemia and hyperkalemia are the risk factors which put the life into danger.⁶

Limited literature is available regarding DKA and its lethal complications in the Pakistani pediatrics population in the recent time as well as in the past. DKA is the cause of load on health system all over the world and it is important to conduct a research in local setting where we find frequency of various complications reported by admitted patients of DKA at the time of admission. So, our aim was to determine the frequency of different complications in admitted patients of diabetic ketoacidosis.

METHODOLOGY

This cross sectional study was done at diabetic ward of National Institute of Child Health Karachi (NICH), from 1st November 2020 to 31st October 2021. Approval from Institutional Research Board was acquired. Informed and written consents were sought from patients or their parents/caregivers. Sample size of 253 was

calculated using WHO sample size calculator: confidence level of 95%, margin of error 2.3% and prevalence of hyperkalemia in DKA patients as 3.6%.⁵ Non-probability consecutive sampling technique was employed.

Inclusion criteria were children of either sex aged 1 to 15 years having diabetes mellitus (disease duration ≥ 3 years) and admitting with DKA were included. Exclusion criteria were rheumatologic diseases (osteoarthritis and rheumatoid arthritis) as per record, infectious diseases (fever of unknown origin or already diagnosed case of tuberculosis, sarcoidosis as per record), recent urinary tract infection (white blood cells more than 3/hpf in urine sample), previous cerebrovascular accident as per medical record), chronic liver diseases as per record of children or those with kidney disease like nephrotic syndrome as per record of the patients.

Demographic detail (including name, age and gender) were obtained. All patients were subjected to detailed history and clinical examination for DKA and its complication (hypoglycaemia, hypokalaemia, hyponatraemia, hypocalcaemia, hyperkalaemia). Diabetes mellitus was defined as fasting plasma glucose level ≥ 126 mg/dL or higher on more than one occasion at least 3 hour apart and the duration of disease ≥ 3 months. Diagnosis of DKA were based on all findings i.e., ketonuria urine ketones $\geq 1+$ hyperglycemia (blood glucose > 11 mmol/L) or > 200 mg/dl) and metabolic acidosis (venous pH ≤ 7.30 to ≥ 6.30 either bicarbonates $\leq 5-15$ mEq/l) in established cases of diabetes mellitus. Hypoglycemia was labeled as blood glucose < 3.3 mmol/L. Hypokalemia was termed as serum potassium < 3.5 mEq/L. Hyponatremia was defined as serum sodium less than 135 mEq/L. Hypocalcaemia was labeled as serum calcium < 2.2 mmol/L. Hyperkalaemia was labeled as serum potassium > 5.5 mmol/L.

The baseline demographic characteristics including weight (assessed by digital weight machine) in kg (in hospital gown only), height in meter (without shoes) squares (assessed by wall mounted scale), BMI, duration of diabetes, type of treatment including the dose and type of insulin were recorded. Blood sample for electrolyte, blood PH and HbA1C were sent to the institute laboratory.

Data were analyzed using SPSS version 26.0. Mean and standard deviation were calculated for quantitative variables like age, weight, height, BMI, HbA1c, pH, Serum potassium, Serum

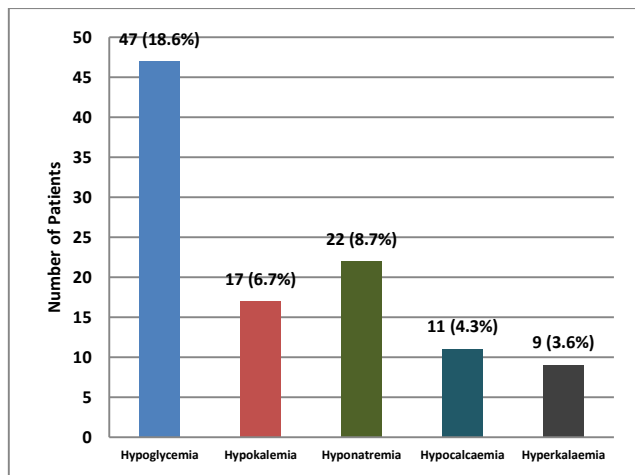
sodium, serumcalcium, duration of diabetes. Frequency and percentages were calculated for qualitative variables like gender, family history of DKA and diabetes and complication (hypoglycaemia, hypokalaemia, hyponatraemia, hypocalcaemia, hyperkalaemia). Effect modifiers like age, BMI, gender, duration of diabetes, family history DKA and diabetes were controlled by stratification. Post stratification chi square test was applied considering $p \leq 0.05$ as significant.

RESULTS

In a total of 253 patients admitted with DKA, 123 (48.6%) were girls and 130 (51.4%) boys. Family history of diabetes mellitus was found in 37 (14.62%) DKA patients, while 10 (4.0%) patients had family history of DKA. There were 15 (5.9%) patients who were obese. Mean age of patients was 6.11 ± 2.87 years, mean BMI 20.9 ± 4.7 kg/m² while mean duration of diabetes mellitus was 3.5 ± 1.2 years.

Mean plasma glucose level was 22.5 ± 6.0 mmol/L (405 ± 108 mg/dl), mean HbA1c (%) 10.2 ± 2.1 while mean pH level was 6.9 ± 0.4 . Mean serum potassium level was 4.1 ± 1.9 mmol/L, mean Serum sodium 135 ± 8.1 mmol/L whereas mean serum calcium level was 2.2 ± 0.4 mmol/L.

According to the different complication of DKA, 47 (18.6%) DKA patients had hypoglycemia, 17 (6.7%) hypokalemia, hyponatremia 22 (8.7%), hypocalcaemia 11 (4.4%) while hyperkalaemia was found in 9 (3.6%) DKA patients as shown in figure-1.



DISCUSSION

In recent times, the prevalence of DKA has been decreasing which is a preventable acute complication of diabetes mellitus.¹⁰ We found 51.4% admitted children with DKA were boys. Roaieid and Kablan¹¹ reported male predominance among patients of DKA while El-Sharief¹² showed that nearly equally proportion boys and girls was found among patients of DKA which is close to what we observed. Variations in gender distribution among patients of DKA could be due to different factors like environment, genetics and social differences. According to a study, the most frequent occurring cause of DKA was infection while poor drug compliance was the other most notable cause of DKA.¹³⁻¹⁴ It shows that diabetic patients coming with infections simultaneously, or with some other severe conditions must be treated promptly because of DKA can result in adverse outcomes if left untreated.¹⁵

As DKA patients are insulin deficient, the level of counter regulatory hormones is raised. In diabetics, three mechanisms of DKA are suggested: 1) Insulinopenia, 2) Elevation of counter regulatory stress hormones, 3) Increased free fatty acid levels.^{16,17} Insulinopenia is found to be the major factor of DKA in some studies on diabetics.¹⁸ Linfoot et al revealed a prominent decrease

in plasma 84 DKA c-peptide concentration in type 1 diabetics when DKA was presented.¹⁹ Hypokalemia, which can disturb secretion of insulin, is an additive risk factor along with fasting for a long time by which rate of ketosis is increased, and resulting into decrease in the secretion of insulin. Linfoot et al did not find any prominent difference between the plasma concentrations of stress hormones and free fatty acids despite elevation of counter-regulatory stress hormones and free fatty acids are the established mechanisms.¹⁹

In this study, we found hypoglycemia, hypokalemia, hyponatremia, hypocalcaemia and hyperkalaemia to be present in 18.6%, 6.7%, 8.7%, 4.6% and 3.6% DKA patients respectively at the time admission. Jayashree M and Singhi S evaluating children with DKA admitted in intensive care unit revealed that hypokalemia was reported in 28% children while hypoglycemia was found in 15% children.²⁰ Abbas Q et al analyzing children with DKA reported that hypokalemia and hyponatremia were observed among 30.8% and 27.7% children respectively but as they analyzed children with severe DKA, proportion of DKA related abnormalities was hypothesized to be high.²¹ Liamis G et al analyzing 113 admitted hypernatremic patients found that 34.5% patients had diabetes mellitus which shows that hypernatremia is a commonly reported electrolyte imbalance among patients of diabetes mellitus.²²

CONCLUSION

Most of the patients admitted with DKA were aged <10 years who developed complications. Hypoglycemia was the most common complication of DKA while hyponatremia the 2nd most frequent complication observed in DKA patients. Electrolytes should be investigated and managed timely to avoid unwanted outcomes among patients admitted with DKA.

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