Research Article ISSN 2639-944X

Journal of Medical - Clinical Research & Reviews

Electrolytes and Enzymes Variations in Diabetic Keto Acidosis

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Received: 22 Dec 2022; **Accepted:** 24 Jan 2023; **Published:** 28 Jan 2023

Citation: Rao Sujatha N, Kuldeep G B. Electrolytes and Enzymes Variations in Diabetic Keto Acidosis. J Med - Clin Res & Rev. 2023; 7(1): 1-3.

ABSTRACT

Objective: *This study aims to evaluate the levels of serum electrolytes and enzymes in diabetic ketoacidosis compared with age matched healthy control population.*

Method*: Cross sectional study involving 94 individuals above the age 60 years in the population of Bengaluru, India between October 2017 to November 2019.Venous blood was collected from 47 type 2 diabetic ketoacidosis patients and from 47 healthy individuals and analyzed for sodium, chloride, potassium, phosphorous electrolytes and serum amylase and lipase enzymes.*

Results: *Serum sodium, potassium and chloride levels were significantly low while serum phosphorous, amylase and lipase levels were significantly high compared to healthy control population.*

Conclusion: *Frequent monitoring of these electrolytes and enzymes in mild stage of diabetic ketoacidosis may help in better treatment and thereby preventing it from progressing into severe diabetic ketoacidosis.*

Keywords

Diabetic ketoacidosis, Sodium, Chloride, Potassium, Phosphorous, Amylase, Lipase.

Introduction

Diabetic ketoacidosis (DKA) is a serious complication of diabetes mellitus that can be life threatening [1,2]. It occurs not only with type 1 diabetes but also with type 2 diabetes [3-6]. In USA 34% of DKA episodes occur in patients with type 2 diabetic patients [4,7,8].

DKA occurs due to absolute or relative deficiency of insulin and increased level of glucagon, cortisol, catecholamines, and growth hormone. Glucose level in blood increases leading to glycosuria which results in polyuria due to osmotic diuresis. Since the body cannot use glucose as fuel in the absence of insulin, it uses fat leading to ketonemia which lowers blood pH leading to DKA [9,10]. As per American Diabetic Association, diagnostic criteria for DKA include [11] plasma glucose concentration higher than 13.9mmol/L, arterial blood pH lower than 7.3 and bicarbonate lower than 18mmol/L. Though many studies were conducted on its clinical presentation [12-14], risk factors [15,16] and treatment [17-19] ,very few studies have been conducted on electrolytes [20-22] and enzymes variations [23-25]. Aim of this study is to determine the levels of sodium, potassium, chloride, phosphate and of Amylase and Lipase enzymes in DKA. Results of this study may be useful for the better management of DKA condition.

Study Design

This is a cross sectional study conducted at the Shree Krishna Sevashrama Hospital, Bengaluru, and Karnataka, India between the period from 19th October 2017 to 14th November 2019. A total of 94 individuals above age 60 years of both the gender were included in this study. After obtaining the Institutional Ethical Committee approval, the subjects were divided into 2 groups. The group 1 comprised of 47 healthy individuals who had availed wellness plan offered by the institution and are above the age 60 years of either gender. Informed consent was collected from these

individuals. The group 2 comprised of 47 type 2 Diabetics with ketosis above the age 60 years. These patients had met the criteria for diabetic ketoacidosis from the American Diabetic Association (11). Age and gender of these patients were obtained from hospital records.

Sample collection and Biochemical Analysis

7 ml of venous blood was collected from the antecubital vein by taking aseptic precautions. The sample was allowed to clot, serum was separated by centrifugation and used for the estimation of sodium, potassium, chloride, phosphorus by Autolab VERSA Clinical Chemistry analyzer manufactured by EuroDiagnostic System Pvt ltd, Chennai, India. Serum phosphorus was analyzed by Molybdate UV method. Serum chloride was analyzed by Photometric test using ferric perchlorate. Serum sodium and serum potassium were analyzed by enzymatic photometric test method. Serum amylase and lipase were estimated by enzymatic method. 24 h urine samples were collected for the detection of ketone bodies in urine by Rothera's test.

Statistical Analysis

The data were expressed as mean ± S.D. All the statistical analysis was performed using the SPSS statistical tool. Student t test was performed to find the difference in the levels of electrolytes and enzymes between diabetics with ketoacidosis and the control group. The results of all the tests with p value < 0.001 was considered as statistically highly significant.

Result

Table 1: Serum Electrolytes and enzyme levels in 2 Study Groups

N=94	Normal Range	Group 1 (Control)	Group 2 (DKA)	P value
Age	≥ 60 years	65 ± 4.4 years	67 ± 6.2 years	0.0865
Male	NA	51(54%)	81 (86%)	0.0001
Female	NA	43 (46%)	13 (14 %)	0.0001
Rothera 's Test	Negative.	Negative	Positive.	NA
Serum Sodium	136-145 mEq/L	138.20 ± 0.89 mEq/L	129.54 ± 0.56 mEq/L	0.0001
Serum Chloride	96-106 mEq/L	102.23 ± 0.54 m Eq/L	93.66 ± 0.73 mEq/L	0.0001
Serum potassium	3.5-5.0 mEq/L	4.42 ± 0.51 mEq/L	4.0 ± 0.22 mEq/L	0.0001
Serum Phosphorous	3-4 mg/dL	3.87 ± 0.52 mg/ dL	5.10 ± 0.25mg/ dL	0.0001
Serum Amylase	40-140 U/L	81 ± 23 U/L	260 ± 40 U/L	0.0001
Serum Lipase	0-160 U/L	43 ± 32 U/L	448 ± 63U/L	0.0001

Table 1 displays the levels of serum sodium, chloride, potassium, phosphorous and enzymes serum amylase and lipase. Average age of control population and DKA patient population was 65 ± 4.4 years and 67 ± 6.2 years respectively. There was no significant difference (p=0.0865) between the two populations with respect to age. Regarding the gender, males and females in control population were 54% and 46% respectively. In DKA population, males and females were 86% and 14% respectively. Number of females was significantly less in DKA population compared to control population (p=0.0001). Number of males were significantly higher in DKA population (p=0.0001). Regarding serum electrolytes, significantly low sodium and chloride was noted in-group 2 DKA (129.54 ± 0.89mEq//L), (93.66 ± 0.73mEq/L) compared to that of control population (138.20 ± 0.89mEq/L), (102.23 ± 0.54mEq/L), p=0.0001). Significantly low serum potassium level was noted in Group 2 (DKA) (4.0 ± 0.22mEq/L) compared to Group 1 (control) 4.42 ± 0.51mEq/L) p=0.0001). Significantly higher serum phosphorous was observed in Group 2 (DKA)5.10 ± 0.25mg/ dL compared to Group 1(control) 3.87 ± 0.52mg/dL, p=0.0001). Serum amylase and lipase levels were significantly high in Group 2 (DKA) (260 ± 40U/L), (448 ± 63U/L) compared to Group 1(control) (81 ± 23 U/L), (43 ± 32U/L)), p=0.0001) respectively.

Discussion

Decreased sodium, chloride and potassium level in serum noted in our study may be due to hyperglycemia, which induces osmotic gradient causing movement of fluid from the cell, leading to dilution hyponatremia [26]. Ketonemia and acidosis in DKA results in decreased renal absorption of sodium and H2O resulting in polyuria and further hyponatremia and hypochloremia and hypokalemia [27-30] .We have noted elevated levels of serum phosphate in our study. This elevation may be due to the movement of phosphorous from intracellular to extracellular compartment due to hyperglycemia through its osmotic effect and the organic anions resulting in its increased levels in serum associated with decreased chloride levels [31,32]. In our study of enzymes, we have noted elevated levels of amylase and lipase. This elevation may be due to the release of nonpancreatic amylase and lipase into the circulation, released due to abnormal metabolism. Elevation also may be due to electrolyte derangement associated with ketoacidosis, which might have damaged the acinar cells of the pancreas releasing their amylase and lipase enzymes into the circulation. [23-25].

Conclusion

In our study of electrolytes and enzymes in diabetic keto acidosis patients, we have observed decreased levels of serum sodium, potassium and chloride and increased levels of phosphorous, amylase and lipase. Therefore, these electrolytes and enzymes concentration should be periodically monitored which help in better management of DKA.

Acknowledgements

Authors thank Sri Krishna Sevashrama Hospital, Bengaluru for giving us an opportunity to conduct this study. Special thanks to Nursing Superintendent Mrs. Judith Fernandes for her help in recording the individual 's age, gender and weight.

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