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*International Journal of Current Research*
*Vol. 9, Issue, 11, pp.61483-61486, November, 2017*

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH**

**ISSN: 0975-833X**

## RESEARCH ARTICLE

# PREVALENCE OF KETOACIDOSIS AMONG DIABETIC CHILDREN VISITING KING ABDULLAH SPECIALIZED CHILDREN'S HOSPITAL EMERGENCY ROOM

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**ARTICLE INFO**

*Article History:*
Received 25th August, 2017
Received in revised form
10th September, 2017
Accepted 11th October, 2017
Published online 30th November, 2017

*Key words:*

Ketoacidosis,
Diabetic children,
Specialized Children Hospital,
Emergency.

**ABSTRACT**

**Background:** Diabetic keto acidosis (DKA) is one of the complicated stages caused by hyperglycemia and low/no levels of insulin in blood. DKA is more common in children with diabetic type 1 more than adult. Since there is lack of data, the present study was conducted to assess the prevalence of DKA among diabetic children visiting KASCH emergency room.
**Aim of the Study:** Our study aiming to measure the frequency diabetic ketoacidosis among children
**Methodology:** This retrospective quantitative case control chart review study was conducted among 182 children diagnosed with Type I Diabetes Mellitus. Biochemical data of the study population was collected from best care database of KASCH. The data was analyzed by using SPSS version 22. Frequencies, percentages, mean, standard deviation, Mann Whitney U test, Spearman's rank correlation were used for the analysis of data. The study was approved by IRB of KAIMRC.
**Results:** The study indicated that type 1 diabetes is more prevalent among females then males**.** Among the subjects 61.5% were with DKA. It was observed that there was no significant difference between plasma glucose levels of those subjects with DKA and without DKA as indicated by Mann Whitney U test. Significant negative correlation was observed between glucose level and $Pco_2$ and pH. Significant correlations were observed between serum electrolytes and ABG values. There is significant difference in the Ca levels of subjects with DKA and without DKA.
**Conclusion:** DKA can effect of homeostasis of the subjects by altering the ABG parameters and electrolytes which can have long term implications in the health of the subjects.



**Citation: Tariq Karrar, Maha Abdallah, Ahmed Alotaibi *et al.* 2017.** "Prevalence of ketoacidosis among diabetic children visiting king abdullah specialized children's hospital emergency room", *International Journal of Current Research*, 9, (11), 61483-61486.

## INTRODUCTION

Diabetic keto acidosis is one of complicated stages caused by increased level of glucose (hyperglycemia) and low levels of insulin in the blood. Also with increases in counter regulatory hormones, its life threating condition can be lethal for children and adults. But DKA is more common in children with diabetic type 1 more than adults. If there is no insulin in the blood or lack of it can lead to hyperglycemia. Because of high level of glucose will increase glucagon level also with resultant gluconeogenesis and glycogenolysis. Excessive level of glucagon increase lipolysis and formation of ketoacidosis. Also hyperglycemia has a major role in losing excessive amount of water and electrolytes by osmotic diuresis after losing large amount of water and electrolyte the patient will be in hypovolemic condition which lead to hypoperfusion in tissue and lactic acidosis and decrease the pH. When we measure the frequency of diabetic ketoacidosis among children, compare arterial blood gases between diabetic and normal children, compare arterial blood gases between diabetic and normal children, To correlate arterial blood gases with plasma glucose level among diabetic patient, correlate serum electrolyte levels with arterial blood gases and correlate between amount of urine ketone bodies with plasma glucose level. This will give us a chart review about all patients which can be easy to read and see the frequency between the patients.

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### Review of the literature

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Recent estimates indicate there were 171 million people in the world with

diabetes in the year 2000 and this is projected to increase to 366 million by 2030. (American Diabetes Association, 2012; Wild *et al*., 2004) Diabetes can be classified into Type 1 diabetes (due to beta-cell destruction, usually leading to absolute insulin deficiency), type 2 diabetes (due to a progressive insulin secretory defect on the background of insulin resistance), Gestational diabetes mellitus (GDM) (diabetes diagnosed in the second or third trimester of pregnancy that is not clearly overt diabetes) and Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes such as neonatal diabetes and Maturity-Onset Diabetes of the Young MODY. With the incidence of both type 1 and type 2 diabetes increasing at an alarming rate, this is a distressing statistic. (American Diabetes Association, 2015; Henk-Jan Aanstoot *et al*., 2007) Diabetic ketoacidosis (DKA) is potentially life-threatening complication in children as same as in adults, however, the child differs from the adult in some characteristics such as difficult to obtain the classical history of polyuria, polydipsia, and weight loss among children in addition to delay in the diagnosis among child. (Josephwolfsdorf *et al*., 2006; Edge *et al*., 2001) DKA is caused by a decrease in effective circulating insulin associated with increases in counter regulatory hormones (glucagon, catecholamines, growth hormone, and cortisol). Although rehydration alone causes some decrease in blood glucose concentration, insulin therapy is essential to normalize blood glucose and suppress lipolysis and ketogenesis. (Owen *et al*., 1981; Luzi *et al*., 1988) There is wide geographic variation in the frequency of DKA at onset of diabetes; rates inversely correlate with the regional incidence of type 1 diabetes. Frequencies range from 15 to 70% in Europe, Australia, and North America. DKA at diagnosis is more common in younger children (<5 years of age) and in children whose families do not have ready access to medical care for social or economic reasons. [9, 10] Laboratory tests used for diagnosis of DKA among children include serum electrolytes, glucose, blood urea nitrogen, calcium, magnesium, phosphorus, hematocrit, and blood gases should be repeated 2–4 hourly, or more frequently, as clinically indicated, in more severe cases, while urine ketones until cleared or blood β-hydroxybutyrate (BOHB) concentrations, every 2 hours. (Ham *et al*., 2004) We aim to study the prevalence and evaluation of Ketoacidosis among Diabetic Children who visit King Abdullah Specialized Children's Hospital Emergence Room in King Abdul-Aziz Medical City.

## MATERIALS AND METHODS

### Study Design:

This study is retrospective quantitative case control chart review study.

### Study Area:

This study will be conducted in King Abdullah Specialized Children's Hospital complex in Riyadh, national guard Saudi Arabia, during the period from September 2016 to January 2017.

### Study Subjects:

### Inclusion criteria:

Children diagnosed with type 1 DM

### Exclusion criteria:

1) Adult diagnosed with DM.
2) Non diabetic children.

## RESULTS

From our results we found that Type I diabetes is more common among females than males. And 61.5% of the children with Type I diabetes were with DKA. Table 1 which give us the Correlation between ABG parameters & Glucose level can see there is $PCO_2$ values and glucose levels of the subjects were negatively correlated it was also found that a significant negative correlation exists between pH and glucose level. Table 2 Plasma Glucose level & Diabetic keto acidosis we can notice that there was no significant difference between plasma glucose levels of those subjects with DKA and without DKA as indicated. Table 3 Serum electrolytes and ABG parameter correlation. A significant negative correlation was observed between $PCO_2$ and $Ca^{++}$. A significant positive correlation was observed between $PCO_2$ and pH. A significant negative correlation was observed between $PO_2$ and Na++. A significant negative correlation was observed between pH and $K^+$ and $C^{++}$. A significant negative correlation was observed between $Na^{++}$ and $K^+$. And significant positive correlation was observed between Na++ and Ca+.

### Descriptive Statistics

| | N | Mean | Std. Deviation |
|---|---|---|---|
| Age (years) | 182<br>182 | 9.4279 | 3.60778 |

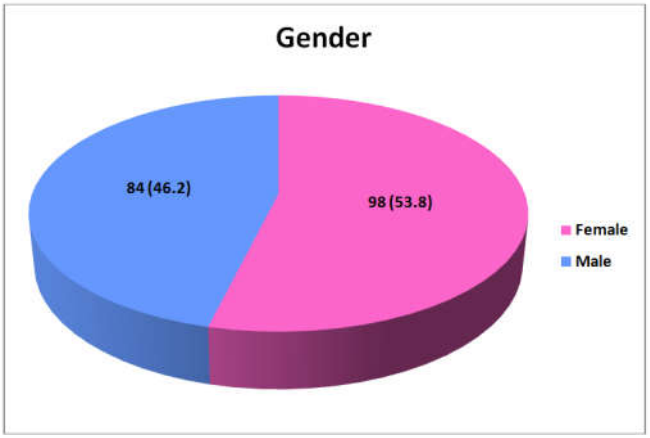


**Fig. 1. Gender distribution of study subjects**

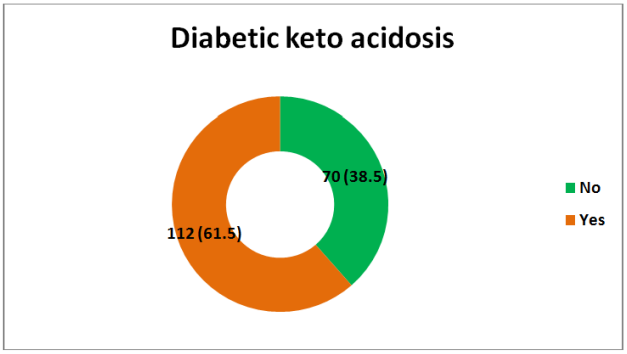


**Fig. 2. Prevalence of diabetic keto acidosis in children**

**Table 1. Correlation between ABG parameters & Glucose level (n= 176)**

| Glucose level | ABG parameters | | |
|---|---|---|---|
| | $PCO_2$ | $PO_2$ | pH |
| Spearman rank correlation coefficient | -0.231 | 0.101 | -0.322 |
| P value | 0.002* | 0.183 | 0.001* |

*Significant at 5%

**Table 2. Plasma Glucose level & Diabetic keto acidosis (DKA), (n= 176)**

| DKA | n | Mean | Standard deviation | Test statistic | P value |
|---|---|---|---|---|---|
| Yes | 108 | 22.49 | 9.52 | U= 3556 | 0.723 |
| No | 68 | 23.04 | 10.92 | | |

Test used- Mann Whitney U test

**Table 3. Serum electrolytes and ABG parameters (n= 176)**

| | | | $PCO_2$ | $PO_2$ | pH | $Na^{++}$ | $K^{+}$ | $Ca^{++}$ |
|---|---|---|---|---|---|---|---|---|
| Spearman's | $PCO_2$ | Correlation Coefficient | | -.404 | .556 | -.007 | -.145 | -.330 |
| | | Sig. (2-tailed) | | 0.001* | 0.001* | .922 | .055 | 0.001* |
| | | N | | 176 | 176 | 176 | 176 | 176 |
| | PO2 | Correlation Coefficient | | | .008 | -.149 | .029 | .027 |
| | | Sig. (2-tailed) | | | .918 | .048* | .702 | .723 |
| | | N | | | 176 | 176 | 176 | 176 |
| | Ph | Correlation Coefficient | | | | .007 | -.277 | -.378 |
| | | Sig. (2-tailed) | | | | .930 | 0.001* | 0.001* |
| | | N | | | | 176 | 176 | 176 |
| | Na | Correlation Coefficient | | | | | -.257 | .303 |
| | | Sig. (2-tailed) | | | | | . 0.001* | 0.001* |
| | | N | | | | | 176 | 176 |
| | K | Correlation Coefficient | | | | | | -.020 |
| | | Sig. (2-tailed) | | | | | | .788 |
| | | N | | | | | | 176 |

Test used- Spearman's rank correlation
*Significant at 5%

**Table 4. Serum Electrolytes & DKA**

| DKA | | N | Mean | Std. Deviation | Test statistic | P value |
|---|---|---|---|---|---|---|
| Na | Yes | 108 | 136.14 | 14.08 | 3388 | |
| | No | 68 | 137.35 | 7.92 | | 0.388 |
| K | Yes | 108 | 4.71 | 3.28 | 3168 | 0.126 |
| | No | 68 | 5.33 | 9.69 | | |
| Ca | Yes | 108 | 1.29 | 0.156 | 2782 | 0.007* |
| | No | 68 | 1.24 | 0.09 | | |

Test Used- Mann Whiney U test
*Significant at 5%

## DISCUSSION

Diabetes ketoacidosis is associated with lack of enough insulin to control blood sugar level, hyperglycemia (Diabetes Care, 2012; Rewers, 2002); in this regard, the body retrieves energy from muscles and fats, which triggers a chemical imbalance called diabetes ketoacidosis (Diabetes Care, 2015). The study results reveal that both negative and positive correlation between arterial blood gases (ABG), blood components, and the counter-regulatory hormones are evident in the samples. presents data on the correlation between ABG parameters and glucose levels of healthy and type 1 diabetes patients. The correlation indicates that when pH levels decrease, glucose levels increase. Low insulin levels, increase catecholamines (Wild, 2004), which stimulate ketogenesis in the liver (Edge, 2001; Ham, 2004). The process releases large amounts of hydrogen ions in urine, as a result affecting the buffer system hence a reduction in pH (Owen, 1981; Wolfsdorf, 2006). Plasma glucose levels in healthy and ailing children are almost similar. (Maniatis, 2005), high glucose concentration in the extracellular compartment triggers an osmotic concentration gradient whereby uptake of water dilutes plasma-sodium concentration, which is released as urine until it reaches equilibrium (Aanstoot, 2007). Consequently, plasma glucose levels are normal in DKA patients. Correlation between electrolytes in serum and the ABG apparatus presents both positive and negative results. As the ketones dissociate, excess hydrogen ions ($H^{+}$) increase the quantity of buffer bicarbonates and decreases serum bicarbonates levels (Luzi, 1988). Therefore, the above process results in creation of a low pH, which has a negative correlation to ABG parameters concerning anion electrolytes; in addition, Sodium ($Na^{+}$) and Potassium ($K^{+)}$ levels decrease (Edge, 2001). Using hypotonic fluids in resuscitation reduces plasma sodium concentration, which causes rapid changes in plasma osmolality. According to Wolfsdorf (2006), the intracellular pool shifts potassium ions, as such, there is increased osmotic concentration gradient which extracts potassium out of cells.

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