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COMPLICATIONS SPECTRUM OF DIABETIC KETOACIDOSIS AMONG CHILDREN OF PEDIATRIC ICU

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Abstract

Objectives: *The purpose of this research work is to elaborate the complications spectrum of DKA (Diabetic Ketoacidosis) as appeared in the children getting treatment of severe diabetic ketoacidosis.*

Methodology: *We carried out the retroactive review of the clinical records of children who got admission with the identification of severe diabetic ketoacidosis in pediatric ICU of Allied / DHQ Hospital Faisalabad from March 2014 to March 2019. We collected all the information on a Performa and we applied the descriptive statistics.*

Results: *Total thirty-seven children got admission with the severe diabetic ketoacidosis (1.90% of total Pediatric ICU admissions with 1.80% in 2014 and 3.40% in 2019). The average age of the patients of this research work was 8.10 ± 4.60 years and 70.0% (n: 26) patients were females. Average Prism-3 score was 9.40 ± 6.0, average GCS on the time of appearance was 11.0 ± 3.80 and average minimum pH was 7.0 ± 0.150. The observed complications included hypochloremia in 35.940% patients, hypokalemia in 30.810%, hyponatremia in 26.7%, cerebral edema in 16.430%, shock in 13.350% children, AKI (Acute Kidney Injury in 10.270%, arrhythmias in 3.80% & TTP (Thrombotic Thrombocytopenic Purpura in 5.40%, whereas only 1 patient was present with myocarditis & one with ARDS. Inotropic support was the need for thirty-five percent patients, thirty percent patients were in need of mechanical ventilation whereas only one patient was in need of renal replacement treatment. Total 5.40% (n: 2) patients met their death in their stay in pediatric ICU.*

Conclusion: *Some most frequent complications of the DKA of severe nature are hypochloremia, some electrolyte abnormalities, cerebral edema and acute kidney infections.*

KEYWORDS: *Diabetic Ketoacidosis, Thrombotic Thrombocytopenic Purpura, Pediatrics, Hypochloremia, Inotropic.*

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INTRODUCTION:

The occurrence of DM (Diabetes Mellitus) is increasing day by day in the whole world. Around 30.0% children suffering from Type-I DM appear with DKA sat the diagnosis time and majority of the children develop diabetic ketoacidosis in the course of this disease. Diabetic ketoacidosis is the one of the leading causes of high rate of mortality particularly because of cerebral edema. In the episode of diabetic ketoacidosis, there are many abnormal processes in the human body including shifts of fluid, reduced perfusion and deranged pH which influenced many operations and results in electrolyte abnormalities. All these reasons can be the cause of infections of many organs of body. The influenced tissues of the brain lead to the cerebral edema. Due to the high morbidity as well as mortality, there is main focus of research in the patients of diabetic ketoacidosis is cerebral edema. There are many reports on separated complications of diabetic ketoacidosis present in this literature. But there is a scarcity of the literature on these related complications of diabetic ketoacidosis among children which are the main cause of the high rate of morbidity as well as mortality and long duration of hospital stay. In this research work, we described the observed complication in the children suffering from diabetic ketoacidosis in our Pediatric-ICU.

METHODOLOGY:

In this study, we retrospectively reviewed the clinical records of all children having age from 1 month to 16 years who got admission in Pediatric-ICU of Allied / DHQ Hospital Faisalabad from March 2014 to March 2019. Ethical committee of the institute gave the permission to conduct this research work. 37 children's suffering from diabetic ketoacidosis who got admission in the duration of this research work were the participants of this research work. We collected the data on a well-organized Performa as details about demography, initial diagnosis, medical variables, laboratory & imaging examination and therapeutic interventions carried out in Pediatric-ICU. The diagnosis of the diabetic ketoacidosis based on the biochemical standard including level of blood glucose greater than 200.0 mg/dl, venous pH less than 7.30 or bicarbonate less than 15.0 moll/L and ketonuria. We categorized the severity of diabetic ketoacidosis on the basis of the acidosis as follows.

DKA of mild nature: Venous pH between 7.210 to 7.3 or bicarbonate between 10.0 mmol/L to 15.0 mmol/L.

DKA of moderate nature: Venous pH between 7.110 to 7.2 or bicarbonate between 5.0 mmol/L to 10.0 mmol/L.

DKA of severe nature: Venous pH less than 7.1 or bicarbonate less than 5.0 mmol/L.

We studied only the patients suffering from diabetic ketoacidosis of severe nature. We managed the patients of severe diabetic ketoacidosis according to the guidelines of ISPAD (International Society for Pediatric & Adolescent Diabetes). We diagnosed every complication according to the international prescribed standards with high rate of accuracy. As we defined the shock with PALS (Pediatric Advanced Life Support) guidelines. We defined the AKI with the risk, loss, failure and end-stage renal standards. SPSS V.23 was in use for the statistical analysis of the collected information. Chi square test was in use for the determination of the danger for developing these complications among various groups.

RESULTS:

Total thirty-seven children suffering from severe diabetic ketoacidosis got admission in the duration of this research work. We observed the complications in seventeen patients. There was a rise in the amount of diabetic ketoacidosis admissions to Pediatric-ICU 1.80% of total Pediatric-ICU admissions in 2014 to 3.40% in 2019. The average age of the patients was 8.10 ± 4.60 years with youngest one with ten months of age. Seventy percent (n: 26) patients were females. Average PRISM-3 (Mean Pediatric Risk of mortality Score Version-III) was 9.40 ± 6.0. The average GCS at the time of appearance was 11.0 ± 3.80 with sixteen (43.0%) having GCS less than 13.0 (Table-1). Total 13 patients were present with shock at the time of presentation and we diagnosed one patient as myocarditis later. Total 4 patients were present with cerebral edema, one patient had to suffer ischemic stroke & arrhythmias was present in 3 patients (all patients were present with ventricular tachycardia).

Table-I: Demographic Characteristics Of Sample

Variable	Frequency / Mean	Percentage / SD
Age (Mean, SD)	8.10	4.60
Weight (Mean, SD)	25.22	13.76
Gender (Female)	26.00	70.00
GCS (Mean, SD)	11.00	3.80
Complications	20.00	54.00
PRISM III Score (Mean, SD)	9.40	6.00
Newly Diagnosed Family History	28.00	75.00
Type-I	3.00	8.00
Type-II	11.00	29.00
Outcome (Survived)	35.00	95.00

There was development of AKI in twenty-seven (n: 10) patients in which there was requirement of renal replacement treatment in only one patient. Whereas only one patient got development of the syndrome of acute respiratory distress.

Table-II: Spectrum Of Complications Of DKA In Children Admitted in PICU (n=37)

Complication		Frequency	Percentage
Cardiac	Shock requiring Inotropic support	13.0	35.00
	Arrhythmias	3.0	8.00
	Myocarditis	1.0	2.70
CNS	Cerebral edema	16.0	43.00
	Stroke	1.0	2.70
Renal	AKI	10.0	27.00
	Hyperchloremia	35.0	94.00
	Hypokalemia	30.0	81.00
	Hyponatremia	26.0	70.00
	Hypernatremia and hyperkalemia	17.0	46.00
Miscellaneous	Respiratory (ARDS)	1.0	2.70
	Hematological (TTP)	2.0	5.40
	Sepsis (Positive Blood culture)	5.0	13.50

Other related details are available in Table-2. Average minimum pH was 7 ± 0.15. Average duration to diabetic ketoacidosis resolution was twenty-three hours. There was requirement of inotropic support for eleven patients whereas one patient was in need of renal replacement treatment. We performed the plasma pheresis in 2 patients for TTP.

Table-III: Values Of Different Laboratory Data In Patients With Severe DKA

Variable	Mean	SD
Highest Glucose (g/dl)	579.240	220.7570
Lowest pH	7.0022	0.150
Highest Base Deficit	-23.2030	-5.873
Lowest Potassium (mmol/L)	2.5240	0.656
Highest Potassium (mmol/L)	4.9970	1.229
Lowest Sodium (mmol/L)	131.730	6.3890
Highest Sodium (mmol/L)	145.620	9.2660
Highest Chloride (mmol/L)	120.860	9.3640
Lowest Phosphorus (mg/dl)	3.0350	1.606

Two patients met their death in their hospitalization stay. The average duration of the stay in the Pediatric-ICU was 2.0 ± 2.80 days. There were more frequent complications in the recently identified patients and in the patients with greater than ten nine years of age (Table-4, Table-5).

Table-IV: Association Of Age With Complications

Complications	Age <8 years	Age > 8 years	P value	OR, 95%CI
Cerebral	0	4.0	0.080	1.2200, 1.000 - 1.480
Stroke	0	1.0	0.400	1.040, 0.950 - 1.140
Arrhythmias	0	3.0	0.130	1.150, 0.980 - 1.360
Shock	6.0	7.0	0.600	0.700, 0.170 - 2.750

OR = odds ratio,95% CI= 95% confidence interval

Table-V: Association Of Type Of Diabetes With Complications

Complications	Fresh Diabetes diagnosis	Previous Known Diabetes	P value	OR, 95%CI
Cerebral edema	1.0	3.0	0.970	0.960, 0.0870-
Stroke	1.0	0.0	0.560	1.030, 0.960-1.140
Arrhythmias	1.0	2.0	0.070	0.130, 0.010-1.640
Shock	12.0	1.0	0.080	6.00, 0.650-54.660

OR = odds ratio, 95% CI= 95% confidence interval.

DISCUSSION:

With the increase of the prevalence of Type-I DM, the rate of occurrence of diabetic ketoacidosis is also increasing and there are high amount of the patients getting admissions in the Pediatric-ICUs due to DKA. Similar is the finding of tis current research work that the amount of the admissions in the Pediatric-ICU because of severe diabetic ketoacidosis doubled from 1.80% in 2014 to 3.60% in the year of 2019. In the past works, there are description of only cerebral edema and some other electrolyte anomalies as the severe complications of diabetic ketoacidosis and its therapy. But with the increase of the occurrence of this disease, there is high amount of the complications available among which some complications are less common. Female patients outnumbered the male patients which is dissimilar to the predominance of the male gender as discovered by Jayashree. According to many previous research works, more than 75.0% patients of the study were newly diagnosed but the European data showed it as 25.0%. Overall complication rate as examined by this research was 54.0% which is much comparable with the findings of previous research studies.

We discovered a very high prevalence of the hyperchloremia in this research work and this has been discovered to be related with the late recovery from diabetic ketoacidosis. Till now, the recommended intravenous fluid treatment for diabetic ketoacidosis is isotonic fluids and this very treatment can cause hyperchloremia but may be very soon in future, many customized fluids will be highly utilized for the prevention of the hyperchloremia as well as its adverse impacts. The average duration of the stay of the patients in the Pediatric-ICU was 2 days which is much lower than the stay reported in the past. Some other less frequent complications as discovered in this research work are TTP (Thrombotic Thrombocytopenic Purpura) in only 2 patients. The management of this complication carried out supportive therapies, Khan already described this in his research work. The only limitation of this research work is that it is study conducted in a single center.

CONCLUSIONS:

There are many common complications of the diabetic ketoacidosis as hyperchloremia, acute kidney infections and cerebral edema. Regardless of these so many complications, the outcome of the patients suffering from diabetic ketoacidosis of severe nature is very good.

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