

## ORIGINAL ARTICLE

**Acute Kidney Injury in Patients with Diabetic Ketoacidosis at National Institute of Child Health**SYEDA SADIA AHMED<sup>1</sup>, MASHAL KHAN<sup>2</sup><sup>1</sup>Resident National Institute of Child Health (NICH)<sup>2</sup>Professor Of Pediatric Medicine National Institute of Child Health (NICH)Corresponding author: Syeda Sadia Ahmed, Email: [Drsadia800@gmail.com](mailto:Drsadia800@gmail.com), Cell: 03212142904**ABSTRACT****Objectives:** To determine the frequency of acute kidney injury (AKI) in patients with diabetic Ketoacidosis at National Institute of Child Health (NICH).**Materials and Methods:** Totally 80 patients who were enrolled. Demographics data were noted. Five ml venous blood sample and urine sample were collected from of each child in aseptic conditions in sterilized container and sent to laboratory of the hospital for random blood sugar (RBS), serum urea, serum creatinine, serum electrolytes (Na, K, Ph,) complete blood count (CBC, hemoglobin (Hb), white blood cells (WBC), platelets count, arterial blood gas (ABG), and ketones. All were drawn at the time of admission and after 24 hours. All children were catheterized at time of admission to monitor urine output which is part of DKA protocol and was recorded at 6, 12, 24 hours. AKI were labelled according to KDIGO classification as stage I, II, III depending upon rise in serum creatinine from baseline or according to urine output at 6, 12, 24 hours. All the demographic details and duration of diabetes mellitus and DKA and its treatment were recorded on a predesigned data collection proforma.**Results:** Out of 80 patients, 44.3% were male and 55.7% were female with mean age of 9.63±3.34 years. 67% of the patients were aged 7.1-14 years, followed by 27% patients were aged 1-7 years and only 5.7% patients were aged of 14.1-18 years. The mean Duration of hospital stay was 6.88±1.45 days. The Mean Hb and WBCs, and Platelets level were 12.13±1.9 g/l, 16.37±7.97 and 348836.3±140355.4 respectively. The mean PH of all the enrolled patients was found 7.08±0.14 and mean Bicarbonate was 7.54±3.37mmol/L. The mean RBS at admission time and after 24-hour treatment were 403.7±95.42 mg/dl and 266.7±65.1 mg/dl respectively. The mean Serum Urea at admission time and after 24-hour treatment were 36.6±28.9 mg/dl and 36.9±23.5 mg/dl respectively. And the mean serum creatinine (mg/dl) at admission time and after 24-hour treatment were 0.75±0.58 and 0.76±0.55 mg/dl respectively. The mean electrolytes (Na, K, Ph) at admission time and after 24 hours were 138.4±7.0 mmol/l and 139.1±4.0 mmol/l, 4.0±0.83 mg/dl and 4.88±4.83 mg/dl, 19.2±30.7 mg/dl and 16.1±22.0 mg/dl respectively. Frequency of AKI was 31.8% and patients needed for peritoneal dialysis were 3.4%.**Practical implication:** In our study it was found out that AKI is a common complication in patients with Diabetic ketoacidosis. So this study will help the clinical practioner to also treat the patients for acute kidney injury that will provide early recovery from all the symptom of acute kidney injury.**Conclusion:** AKI is a common complication in children who are admitted for DKA and clinical practitioner should take precautionary parameter to avoid such complication.**Keywords:** Acute Kidney Injury, Diabetic Ketoacidosis, Children, DM, DM Type-1, child health, Frequency, NICH**INTRODUCTION**

Diabetes Mellitus especially DM Type-1 is a life-threatening disorder that is increasing throughout the world. It is characterized by inadequate control of blood glucose level <sup>(1)</sup>. International Diabetes Federation (IDF) reported the higher prevalence of DM Type-1 in children and adolescents with age of less than 20 years. One of the complications of DM Type-1 is Diabetic ketoacidosis (DKA) that is also a life-threatening disorder. DKA can occur in both DM Type-1 and DM Type-2. But the prevalence of DKA due to DM type-1 vary between 12%-80% in pediatric population globally. In Pakistani population a high incidence 75.83% of DKA was reported in DM type 1.

It has been stated that the incidence of DM would be 69.9 million in Indian population and 11.6 million in Pakistani population by 2025 <sup>(2, 3)</sup>. Diabetic ketoacidosis (DKA) is a serious, potentially lethal, and acute complication of type 1 DM in children, which is associated with increased morbidity and mortality. It is caused by insulin deficiency. Globally, diabetic ketoacidosis vary between 12-80%.<sup>(4)</sup> In Pakistani population there are approximately 75.83% children with diabetic ketoacidosis in type 1 diabetes. <sup>(5)</sup>

Acute kidney injury (AKI) take place most commonly in children with diabetic ketoacidosis (DKA), but its onset mechanisms are unclear <sup>(6)</sup>. AKI was associated with lower serum HCO<sub>3</sub> levels (<10 mmol/L) <sup>(7)</sup>. DKA is associated with dehydration and electrolyte imbalance that lead to AKI <sup>(8)</sup>. In East Asian population the prevalence of AKI in Peads with DKA have not been reported. DKA is characterized by hyperglycemia (blood glucose level >200 mg/dL) and low pH (pH<7.3) or bicarbonate (<15 mEq/L) levels with raised urine or serum ketones <sup>(9)</sup>.

Acute kidney injury (AKI), previously referred to as acute renal failure, is a common event in hospitalized children and implies a sudden worsening of the kidney's ability to function. The

clinical manifestations of pediatric AKI range from a mild increase in serum creatinine to a neric renal failure that requires dialysis. The most common risk factor for pediatric AKI is prerenal disease or volume-responsive AKI, which is caused by hypovolemia and reduced renal perfusion. If a prerenal insult is severe or prolonged, the injury can result in structural damage to the renal parenchyma, a condition known as acute tubular necrosis. Despite the marked intravascular volume depletion that occurs in DKA and subsequent cautious fluid-rehydration strategies, AKI in children with DKA has not been systematically studied <sup>(9)</sup>.

Limited data is available on the prevalence of AKI in children and adolescents with DKA. Along with morbidity and mortality, AKI is also significantly associated with increased risk of chronic renal disease.

Therefore, we conducted this prospective study in our setup to find out current frequency of acute kidney injury in children and adolescents with DKA. Therefore, strategies are needed to improve the diagnosis, management, and follow-up of AKI in children with type 1 DM and DKA.

**Objective:** To determine the frequency of acute kidney injury in patients with diabetic Ketoacidosis at NICH.

**MATERIALS AND METHODS**

**Study Design and setting:** The Prospective Cross-sectional study was conducted on endocrinology department of National institute of child health Karachi (NICH).

**Duration of the study:** Duration of the study was 9 months (Jan 2022–Sep 2022).

**Sample Size:** The sample size was calculated by using online Open Epi Sample size software by proportion of Baalaaji M, et al. who reported the 35.4% children of diabetic ketoacidosis with

acute kidney injury <sup>(10)</sup>, by taking confidential interval 95% and margin of error 10%. Sample size was calculated n=88.

**Inclusion Criteria:**

- Children of 1-18 years of age.
- Both genders.
- All children with type 1 diabetes admitted at NICH presenting with DKA

**Exclusion Criteria:**

- Children presenting with DKA along with chronic cardiac disease or chronic renal failure.
- Parents of children not willing to participate in study.

**METHODS**

After the permission of Research evaluation unit (REU) of College of Physicians and Surgeons Pakistan (CPSP), a total of 88 patients were enrolled and written informed consent for the study was obtained from the guardian of children. All the demographic and clinical data such as shortness of breath, irregular heartbeat, fatigue, weakness, nausea, fluid retention (causing swelling in legs, ankles or feet), anuria or oliguria was collected according to predesigned questionnaire. Duration of DM and DKA and its treatment were also noted. Five ml of venous blood and urine sample of each child was collected using aseptic techniques and sent for random blood sugar (RBS), serum urea, serum creatinine, serum electrolytes (Sodium (Na), Potassium (K), Phosphorus (Ph) and Chlorine (Cl), complete blood count (CBC, hemoglobin (Hb), white blood cells (WBC), platelets count), arterial blood gas (ABG) and ketones.

All were drawn at the time of admission and after 24 hours or as recommended by the treatment protocol of DKA. All children were catheterized at time of admission to monitor urine output, which is part of DKA protocol, were recorded at 6, 12, 24 hours. AKI were labelled according to KDIGO classification as stage I, II, III depending upon rise in serum creatinine from baseline or according to urine output at 6, 12, 24 hours. Those children who received peritoneal or hemodialysis were recorded. Outcome were recorded as alive or expired. Data taken from the first laboratory results and after 24 hours were used in this study.

**Statistical Analysis:** SPSS (version 25.0) was used for the analysis of data. The data was presented in the form of table and graph.

**RESULTS**

A total of eighty-eight patients with mean age of 9.63± 3.34 years were enrolled. Out of total, 44.3% children were male, and 55.7% children were female (Table 2-0, Fig 1-0). 67.0% of the patients were aged 7.1-14 years, followed by 27.3% patients were aged 1-7 years and only 5.7% patients were aged of 14.1-18 years (Table 2-0). The mean Duration of hospital stay was 6.88±1.45 days. The Mean Hb and WBCs, and Platelets level were 12.13±1.9, 16.37±7.97 and 348836.3±140355.4 respectively. The mean PH of all the enrolled patients was found 7.08±0.14 and mean Bicarbonate was 7.54±3.37. The clinical parameter and electrolytes at the time of admission and after 24hours, and AKI severity are summarized in table 2-0 and table 3-0. Stratification of different variables on the basis of AKI was done and shown in table 4-0.

Table 1: Clinical Characteristics of Patients (n=88)

Variable	Mean	SD
Age (Years)	9.63	3.34
Duration of hospital stay (Days)	6.88	1.45
Duration of DKA (Hours)	14.87	6.27
Ketone (mmol/L)	2.87	0.39
HB (gm/L)	12.13	1.90
WBC	16.37	7.97
Platelets	348836.3	140355.4
ABG:		
PH	7.08	0.14
Bicarbonate (mmol/l)	7.54	3.37

HB= Hemoglobin, RBC= Red blood cells, WBC= White blood cells, ABG= Arterial blood gas.

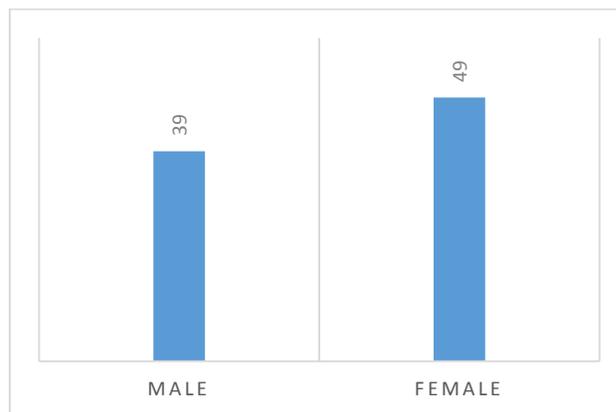


Figure 1: Graphical Representation of gender

The patients were distributed, and it was found that 65.0% patients fell in moderate category of DKA followed by severe category in which 31.0% patients and in mild category there were only 4.0% patients. Fifty two percent patients were treated for more than 24 hours, and 48.0% patients were treated for less than 24 hours. In this study only 3.4% patients were expired. And 3.4% patients needed peritoneal dialysis.

Table 2: Clinical Characteristics of Patients at The Time of Admission and After 24-Hour Treatment (n=88)

Variable	At Admission	At 24 Hours
	Mean± SD	Mean± SD
RBS	403.7±95.42	266.7±65.1
Urea (mg/dl)	36.6±28.9	36.9±23.5
Creatinine (mg/dl)	0.75±0.58	0.76±0.55
Electrolytes:		
Na (mmol/l)	138.4±7.0	139.1±4.0
K (mmol/l)	4.0±0.83	4.88±4.83
Ph (mg/dl)	19.2±30.7	16.1±22.0

Table 3: Distribution of Patients on The Basis of Different Variables (n=88)

Variables	Frequency	Percentage
Age Group (Years):		
1-7	24	27.3
7.1-14	59	67.0
14.1-18	5	5.7
Gender:		
Male	39	44.3
Female	49	55.7
Severity of DK:		
Mild	5	5.7
Moderate	53	60.2
Severe	30	34.1
Duration of DK treatment:		
<24 hour	36	40.9
>24hour	52	59.1
Outcome:		
Alive	85	96.6
Expired	3	3.4
AKI:		
Yes	28	31.8
No	60	68.2
Stages of AKI		
No AKI	61	69.3
Stage 1	14	15.9
Stage 2	10	11.4
Stage 3	3	3.4
Need for Dialysis		
Yes	3	3.4
No	85	96.6
Total	88	100.0

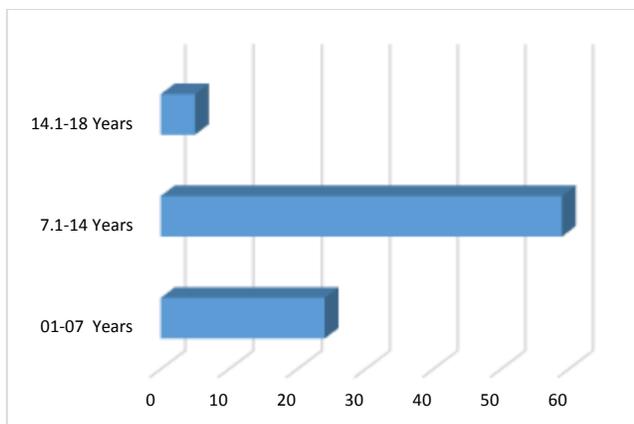


Figure 2: Graphical Representation of Distribution of Patients According to Age Group (n=88)

Table 4: Stratification of Different Variables on The Basis of AKI (n=88)

Acute Kidney Injury			
Variable	Yes	No	P- Value
<b>Gender</b>			
Male	13	26	0.48
Female	15	34	
<b>Age group</b>			
1-7 years	4	19	0.05
7.1-14 years	21	40	
14.1-18 years	3	1	
<b>Severity of DK</b>			
Mild	1	4	0.46
Moderate	15	38	
Severe	12	18	
<b>DK treatment</b>			
<24 hour	9	27	0.25
>24hour	19	33	

## DISCUSSION

Acute kidney injury (AKI), also term as acute renal failure (ARF), is a worst condition of kidney failure that results in a decline glomerular filtration rate (GFR) within a few hours. This study was conducted in order to determine the frequency of acute kidney injury in patients with diabetic Ketoacidosis. Different studies reported different prevalence rate of AKI in patients with DKA throughout the world<sup>(8, 9)</sup>. In a study conducted by Hursh et al. reported a prevalence of AKI of 64.3% in children suffering from DKA<sup>(9)</sup>. In another study conducted in India, the prevalence of AKI in children with DKA was only 35.4%. in our study<sup>(8)</sup>. In our study the prevalence rate of AKI was 31.8% with most of the patients fell in the stage-1 category, that was near to the Indian prevalence rate<sup>(8)</sup>. A recent Israelian study showed that the proportion of AKI in children with DKA was 30%, this is resemble to our study<sup>(11)</sup>.

In our study we found no such mean difference in Creatinine level at the time of admission and after 24-hour treatment. It is worth noting that the serum creatinine level is an insensitive and delayed marker of AKI. Thus, the kidneys may loss its function due to injury before serum creatinine levels are raised, (12) which mean that the actual prevalence of AKI in children suffering from DKA might be higher than expected. In our study the mean PH and Bicarbonate were with low mean. In a study conducted by Lee MH et al<sup>(13)</sup> stated that a low pH levels at the time of admission in adult needs longer time for DKA resolution. The role of bicarbonate in the treatment of DKA remains controversial.<sup>(14)</sup> While there may be some indication for its use in severe DKA with pH <6.9,<sup>(15)</sup> In our study, mean DKA treatment duration was 14.87±6.2 hour, similar to some previous studies<sup>(16, 17)</sup>. Hyperglycemia was faster to normalize than ketoacidosis, also consistent with previous findings<sup>(18)</sup>. In our study, at the time of admission the RBS level is so much high but after treatment of 24 hour this high-level drop rapidly.

## CONCLUSION

AKI is highly prevalent disorder in children and adolescents admitted for the treatment of DKA. The clinical practitioner should note that AKI is a common complication in children who are admitted for DKA and should take precautionary parameter at initial stages to avoid such complication.

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