Original Article

Acute Kidney Injury among Adult Patients with Diabetic Ketoacidosis in a Referral Hospital of Bangladesh

Rahim MA[a*], Ananna MA[a*], Zaman S[b], Rouf R[c], Ahmed AU[d], Hossain RM[e], Chowdhury TA[f], Saha SK[f], Samad T[a], Mitra P[g], Iqbal S[h], Uddin KN[i], Latif ZA[j]

Abstract

Background: *Diabetic ketoacidosis (DKA) is a medical emergency. DKA may be complicated by acute kidney injury (AKI) and may require renal replacement therapy. Early detection and treatment including treatment of underlying cause and complication(s), if present, is important in determining outcome of DKA. This study was designed to evaluate the incidence of AKI among patients with DKA.*

Methods: *This cross-sectional study was done in BIRDEM General Hospital, Dhaka, Bangladesh from 2008 to 2011. AKI was diagnosed by using acute kidney injury network (AKIN) criteria.*

Results: *Total patients were 200 with slight female predominance (56%). Mean age of the study subjects was 37.6±7.5 years. Incidence of DKA was more in known diabetic patients (71%), more among rural population (53%) and low income group (76.5%). Infection (40.5%) was the commonest precipitating cause followed by non-adherence to insulin therapy (31%). Acute pancreatitis (5%), myocardial infarction (2%), stroke (1%) and surgery (1.5%) were less common causes and aetiology could not be identified in 14% cases. Fifty nine (29.5%) cases were complicated by AKI and among them three (5%) patients required haemodialysis. AKI was more in severe DKA (pH <7) cases and when precipitated by acute pancreatitis and infections. In spite of standard management overall mortality was 6.5%.*

Conclusion: *Almost one-third of DKA cases had AKI in this study, more in DKA cases precipitated by acute pancreatitis and sepsis. Fluid resuscitation resolved AKI in most cases but few cases required renal replacement therapy.*

Key words: *acute kidney injury, Bangladesh, diabetic ketoacidosis, incidence.*

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Author Information

a. Muhammad Abdur Rahim, Mehruba Alam Ananna, Tabassum Samad, Assistant Professor, Department of Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh.

b. Shahana Zaman, Junior Consultant, Department of Cardiology, NICVD, Dhaka, Bangladesh.

c. Rozana Rouf, Senior Medical Officer, Department of Endocrinology, BIRDEM General Hospital, Dhaka, Bangladesh.

d. Ashraf Uddin Ahmed, Resident Physician, BIRDEM General Hospital, Dhaka, Bangladesh.

e. Rana Mokarram Hossain, Associate Professor, Department of Nephrology, BSMMU, Dhaka, Bangladesh.

f. Tufayel Ahmed Chowdhury, Shudhanshu Kumar Saha, Registrar, Department of Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh.

g. Palash Mitra, Assistant Registrar, Department of Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh.

h. Sarwar Iqbal, Professor, Department of Nephrology, BIRDEM Geneal Hospital, Dhaka, Bangladesh

i. Khwaja Nazim Uddin, Professor, Department of Internal Medicine, BIRDEM General Hospital, Dhaka, Bangladesh.

j. Zafar Ahmed Latif, Professor, Department of Endocrinology and Director, BIRDEM Academy, Dhaka, Bangladesh.

*First two authors had equal contributions and should be considered as first authors

Address of correspondence: Muhammad Abdur Rahim, Assistant Professor, Department of Nephrology, BIRDEM General Hospital, Dhaka, Bangladesh. Email: muradrahim23@ yahoo.com

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Introduction

Diabetic ketoacidosis (DKA) is one the most common and serious hyperglycaemic emergencies among patients with diabetes mellitus (DM). Over three-quarter of type 1 diabetic patients may first present with DKA, but DKA commonly complicates previously diagnosed diabetic patients of any type specially if they get infection or become non-compliant to insulin treatment.[1-4] Treatment of DKA is aimed to correct dehydration, hyperglycaemia, electrolyte imbalance and infection, if present. Outcome depends on rapidity of diagnosis and treatment initiation, severity of the disease, age of the patient, precipitating factor, presence of co-morbidities and organ dysfunction including acute kidney injury (AKI).[5-7]AKI incidence is reported to be very high in DKA in children, but less well studied among adult patients.[8.9] This study was designed to evaluate the incidence of AKI among adult DKA patients in a tertiary care hospital of Bangladesh.

Methods

This cross-sectional study was done in the Department of Nephrology, Department of Internal Medicine, Department of Endocrinology and Department of Critical Care Medicine of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka, Bangladesh over a period of four years starting from January 2008. The study protocol was approved by Bangladesh College of Physicians and Surgeons (BCPS). Hospitalized adult patients with a clinical diagnosis of DKA (211) primarily constituted the study population. Diagnosis of DKA and classification was done by using American Diabetic Association (ADA) criteria.[10] Patients with ketonuria and high blood glucose with normal arterial *p*H (11) were excluded from the study. AKI was diagnosed according to acute kidney injury network (AKIN) criteria.[11] Patients were monitored clinically including hourly urine output measurements. Routine investigations including complete blood count, serum electrolytes, urea, creatinine, urine routine examinations were done for all patients. Culture of appropriate samples and imaging were done as necessary. All the data including socio-demographic characteristics, clinical presentations, physical findings, laboratory parameters, treatment and outcome were recorded in preformed case record forms. Data were analyzed by SPSS version 12.0 and results were presented in tables.

Results

Total number of patients was 200 including 88 males. Base-line characteristics are presented in Table I. DKA occurred mostly among low income group (monthly income <6000 Bangladeshi taka, 76.5%) and patients with poor glycaemic control (HbA1c >7% in 94%).

Table I. Base-line characteristics of the study population (N=200)

Characteristics	Results
Mean age (years)	37.6±7.5
Male: Female	1:1.3
Known DM*: New diagnosis of DM	2.4:1
Rural: Urban	1.1:1
Mean RBG** at admission (m.mol/L)	27.1±7.5
Mean HbA1c (%)	11.3±3.7
Severe acidosis (*p*H <7)	8.5%

*DM= diabetes mellitus, **RBG= random blood glucose

Common presentations, severity of DKA and precipitating causes are shown in Table II, Table III and Table IV respectively. Neutrophil leukocytosis was present in 87% cases, irrespective of presence of infection. Gross electrolyte imbalance at admission was less common but 97% patients required potassium infusion during treatment. Fifty nine (29.5%) of the patients were complicated with AKI, among them three (3/59, 5%) patients required haemodialysis. AKI was more in severe DKA cases (Table III) and in cases those were precipitated by acute pancreatitis, sepsis/infection and surgery (Table IV). In spite of standard management, mortality was 6.5%.

Table II. Clinical presentation of the study populations (N=200)

Features*	Frequency (Percentage)
Nausea	126 (63)
Vomiting	122 (61)
Polyuria	86 (43)
Polydipsia	85 (42.5)
Fever	58 (29)
Abdominal pain	56 (28)
Shortness of breath	56 (28)
Blurred vision	26 (13)
Coma	14 (7)

*All patients had more than one symptom

Table III. Severity of DKA10 among the study subjects and distribution of AKI among them (N=200)

Severity of DKA	Frequency (%)	AKI (frequency, %)
Mild (*p*H 7.25-7.30)	72 (36)	0 (0)
Moderate (*p*H 7.0-7.24)	111 (55.5)	44 (39.6)
Severe (*p*H <7.0)	17 (8.5)	15 (88.2)

Table IV. Precipitating causes of DKA and distribution of AKI among them (N=200)

Causes	Frequency (Percentage)	AKI (frequency, %)
Infection	91 (40.5)	32 (35.2)
Non-compliance	62 (31)	8 (12.9)
Acute pancreatitis	10 (5)	9 (90)
Acute myocardial infarction	4 (2)	0 (0)
Surgery	3 (1.5)	2 (66.7)
Stroke	2 (1)	0 (0)
Unidentified	28 (14)	8 (28.6)

Discussion

Acute and reversible deterioration of renal function is used to define acute renal failure. AKI occurs in one-fourth of acute admissions[12] and in half of the cases in intensive care settings.[13] In-hospital and long-term outcome of hospitalized patients are independently determined by presence of AKI during hospitalization.[14-16]

AKI is a recognized complication of DKA. Several case reports emphasized underlying causes including drugs and acute pancreatitis, rhabdomyolysis, leptospirosis and acute viral hepatistis[17-19] as the determinant of AKI. As osmotic diuresis leading to dehydration is the most common mechanism of pre-renal AKI in the setting of DKA[9], rehydration remains as the main therapeutic intervention. In a small number of cases specific therapy like haemodialysis is required. Obran J-C *et al.*[9] in a ten year retrospective study found that only 3% patients with DKA complicated by AKI required dialysis. In our study, 5% cases of AKI among DKA patients required dialysis.

Pancreatitis and sepsis can cause AKI and multi-organ failure.[17,19] Severe pancreatitis may lead to DKA even in non-diabetic patients carrying a bad prognosis.[20] Our study findings also support this. These patients require organ supports in addition to correction of dehydration, hyperglycaemia and electrolyte imbalance as part of DKA management. Long-term mortality of DKA patients are also determined by incident AKI during DKA episode.[15]

In current study, the overall mortality was 6.5%, which was comparable with other studies in developing as well as developed countries.[4,20-22] Death occurred mostly in patients who presented late or were referred from other hospitals, had pancreatitis and sepsis as aetiology and those cases who were complicated by AKI. AKI resulting from intravascular volume contraction or dehydration in DKA responded rapidly on rehydration, but infectious cases and DKA precipitated by acute pancreatitis required special attention.

In conclusion, it can be said that, AKI is common in DKA, may occur in up to one-third of cases. Most cases require no extra care, with treatment of DKA, AKI resolves. But if DKA is precipitated by acute pancreatitis or sepsis, these cases may require extra attention, may require organ supports including dialysis, most likely on a temporary basis.

Conflict of interest: Nothing to declare.

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