Brief Communication

Clinical Characteristics and Outcome of Diabetic Ketoacidosis: Experience at BIRDEM, Dhaka, Bangladesh

Muhammad Abdur Rahim[1], Rozana Rouf[2], Ashraf Uddin Ahmed[3], Palash Mitra[4], Shahana Zaman[5], Khwaja Nazim Uddin[6], Zafar Ahmed Latif[7]

Abstract :

Background: *Diabetic ketoacidosis (DKA) is a medical emergency. It may be the presenting feature of diabetes mellitus, but more commonly DKA complicates diabetic patients during inter-current acute illness or if they become non-compliant to anti-diabetic medications. Early detection and treatment of DKA including underlying cause is important in determining outcome.*

Objectives: *To describe the demographic characteristics, presentations, precipitating factors and outcome of DKA.*

Methods: *This cross-sectional study was conducted at BIRDEM General Hospital from January 2008 to December 2011.*

Results: *Total patients were 200 with female predominance (56%). Mean age of the study population was 37.6 years. Incidence of DKA was more in known diabetic patients (71%) than in new cases (29%), more among rural population (53%) and low income group (76.5%). Common presentations included nausea (63%), vomiting (61%), polyuria (43%), polydypsia (42.5%), fever (29%), abdominal pain (28%), shortness of breath (28%), drowsiness (20%), blurred vision (13%), leg cramps (6.5%) and coma (7%). Infection (45.5%) was the commonest precipitating cause of DKA followed by non-adherence to insulin therapy (31%). Acute pancreatitis (5%), myocardial infarction (2%), stroke (1%) and surgery (1.5%) were less common precipitating factors. Aetiology of DKA could not be identified in 14% cases. Mean random blood glucose during admission was 27.1mmol/L and mean HbA1c was 11.3%. Severe acidosis (pH<7) was less common (8.5%). Neutrophil leukocytosis was present in 87% cases, irrespective of infection. In-hospital mortality was 6.5%.*

Conclusion: *DKA occurred in diabetic patients in over two-third of the cases. In over two-third of the study population, DKA was precipitated by infection and non-adherence to insulin treatment. So, patient education regarding treatment compliance and sick days' management are important and may prevent many cases of DKA.*

Key words: *clinical characteristics, diabetic ketoacidosis, precipitating causes, presentations, outcome.*

Introduction :

Diabetic ketoacidosis (DKA) is the commonest hyperglycaemic

1. Dr. Muhammad Abdur Rahim, MBBS, FCPS (Medicine), Assistant Professor, Department of Nephrology and Dialysis, BIRDEM General Hospital, Dhaka, Bangladesh.

2. Dr. Rozana Rouf, MBBS, Senior Medical Officer, Department of Endocrinology, BIRDEM General Hospital, Dhaka, Bangladesh.

3. Dr. Ashraf Uddin Ahmed, MBBS, FCPS (Medicine), Specialist, Department of Neurology, Square Hospitals Ltd, Dhaka, Bangladesh.

4. Dr. Palash Mitra, MBBS, Assistant Registrar, Department of Nephrology and Dialysis, BIRDEM General Hospital, Dhaka, Bangladesh.

5. Dr. Shahana Zaman, MBBS, FCPS (Cardiology), Registrar, Department of Cardiology, National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh.

6. Prof. Khwaja Nazim Uddin, MBBS, FCPS, FACP, FRCP, Professor of Medicine, BIRDEM General Hospital, Dhaka, Bangladesh.

7. Prof. Zafar Ahmed Latif, MBBS, FCPS, Professor of Endocrinology and Director, BIRDEM Academy, Dhaka, Bangladesh.

Corresponding Author:

Dr. Muhammad Abdur Rahim
Assistant Professor
Department of Nephrology and Dialysis BIRDEM General Hospital
Dhaka-1000, Bangladesh, Email: muradrahim23@yahoo.com.

emergency amongst diabetic patients. Over three-quarters 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 infected or become non-compliant to insulin treatment[1-4]. Many undiagnosed type 2 diabetic patients also present first time with DKA, if infected[4-6]. Type 1 diabetic patients may have classic presentations, but type 2 diabetic patients vary in their presentations, often non-specific symptoms and features of infection predominate[4,5,7]. Diagnosis of DKA is straight-forward. Demonstration of high blood glucose level, ketone bodies in urine or blood and acidosis in arterial blood gases are sufficient to make the diagnosis of DKA. Treatment is aimed to correct dehydration, hyperglycaemia, electrolyte imbalance and underlying cause, if identified. Outcome depends on rapidity of diagnosis and treatment initiation, severity of acidosis, age of the patient, precipitating factors, presence of co-morbidities and organ(s) dysfunction[8-11]. This study was aimed to describe the demographic characteristics, presentations, precipitating factors and outcome of DKA in a tertiary level hospital of a developing country.

Materials and Methods :

This cross-sectional study was done in the Department of

Internal Medicine, Endocrinology and 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. Hospitalized adult patients with a clinical diagnosis of DKA primarily constituted the study population. Diagnosis and classification of DKA was done by using American Diabetic Association (ADA) criteria[11]. Patients with ketonuria, high blood glucose level with an arterial blood pH>7.30 were excluded from the study. All data including demographic characteristics, presentations, laboratory parameters, treatment and outcome were recorded in preformed pretested case record forms. Data were analyzed by statistical package for social science (SPSS) version 12.0.

Results :

Total number of patients were 200, male were 88 (44%) and female were 112 (56%). Mean age of the study population was 37.6±7.5 years. Among the 200 patients, 142 (71%) were known diabetic patients. Base-line characteristics and status of diabetes mellitus (DM) are presented in table I and table II respectively. DKA occurred mostly among low income group (monthly income <6000 Bangladeshi taka) (76.5%) and patients with poor glycaemic control (HbA1c >7% in 94%).

Severe DKA (pH<7) was less common (table III). Common presentations and precipitating causes are shown in table IV and table V respectively.

Table III: Severity of DKA[11] of the study population (N=200)

pH	Frequency	Percentage
<7	17	8.5
7-7.24	111	55.5
7.25-7.30	72	36

Table IV: Clinical presentations 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
Drowsiness	40	20
Blurred vision	26	13
Coma	14	7

*All patients had more than one symptom

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 (mmol/L)	27.1±7.5
Mean HbA1c (%)	11.3±3.7

*RBG= random blood glucose

Table II: Status of DM in the study population (N=200)

Status of DM	Frequency	Percentage
Newly detected DM	58	29
Known DM	142	71
Treatment of known DM (n=142)		
Insulin	88	62
OAD*	23	16.2
Insulin+OAD	28	19.7
MNT**	3	2.1
RBG at presentation (m.mol/L)		
<20	27	13.5
21-25	25	12.5
26-30	116	58
31-35	19	9.5
>35	13	6.5
HbA1c (%)		
<7	12	6
7-8.5	9	4.5
8.6-10	53	26.5
>10	126	63

*OAD=oral anti-diabetic drugs, **MNT=medical nutrition therapy

Table V: Precipitating causes of DKA (N=200)

Causes	Frequency	Percentage
Infection	91	45.5
UTI*	67	33.5
Pulmonary tuberculosis	6	3
Pneumonia	11	5.5
Liver abscess	3	1.5
Diabetic foot	4	2
Non-compliance	62	31
Insulin omission	49	24.5
Reduction of insulin dose	13	6.5
Myocardial infarction	4	2
Stroke	2	1
Acute pancreatitis	10	5
Surgery	3	1.5
Unidentified	28	14

*UTI=urinary tract infection

Neutrophillic leukocytosis was present in 87% cases. Gross electrolyte imbalance at admission was less common but 194 (97%) patients required potassium infusion during treatment. Fifty nine (29.5%) patients were complicated with acute kidney injury (AKI). In-hospital mortality was 6.5%.

Discussion :

In this cross-sectional study, we have evaluated the demographic characteristics including age and sex, status of DM, anti-diabetic medications, presentations, investigations, precipitating causes, initial treatment and in-hospital outcome of patients with DKA. We found that DKA occurred mostly in known diabetic patients, more in females and low income group, which is consistent with three different reports from Kenya, Bangladesh and Taiwan[12-14]. Ahmed AU et al. explained that poverty and social inequalities are responsible for gender discriminations even in care for medical needs for chronic diseases like diabetes in developing countries like that of Bangladesh[13].

Most patients in this study had non-specific symptoms of nausea, vomiting rather than classic presentations of polyuria, polydipsia, shortness of breath and coma. Rahim MA et al. also reported similar findings[4]. Presentations also differ upon type of diabetes and precipitating causes[2-4,11].

All patients in this study had high blood glucose and high HbA1c levels. Poor glycaemic control is a consistent feature of DKA except cases precipitated by acute pancreatitis[4,12,13]. Neutrophillic leukocytosis was common irrespective of infection, which may be explained by haemo-concentration. Mbugua PK et al. also described similar findings[12]. We observed that nearly one-third of the cases were complicated with AKI. Orban J-C et al. in their study found that half of the patients with DKA had AKI[15]. Regarding management of AKI in DKA, no patient required extra attention except correction of dehydration in immediate periods following hospital admission in current study but three out of 94 patients required haemodialysis within 24 hours of admission in the study done by Orban JC et al[15].

Precipitating causes of DKA were not different in this study from previous studies[4,13,16-18]. Infection and non-compliance to anti-diabetic medications were common precipitants. Urinary tract infection was the commonest infection in the current study. Jabbar A et al. found that in two-third of type 2 diabetic patients, DKA was precipitated by infection and after recovery from DKA, many of them were on oral anti-diabetic drugs without recurrence of DKA[5]. This observation explains that infection can unmask previously undiagnosed type 2 diabetes, as reported by Pinto ME et al[19]. In different studies it was found that in up to 25% patients precipitating causes could not be identified[4,14].

Outcome of this study showed that 6.5% patients expired in hospital. Almost similar results were found in two different reports from Bangladesh[4,20]. Outcome is variable, depends upon early diagnosis and onset of treatment, underlying causes and standards of care[11,13]. Mortality was 14% in UK, 4% in Denmark, 11.8% in Korea and 29.8% in Kenya.[21,22,10,12]. With better understanding of the pathophysiology of DKA and improvements in treatment, outcome is improving[23,24].

Current study had some limitations. We could not classify the patients as having type 1 or type 2 diabetes and many of the study subjects had fibro-calcific-pancreatic-diabetes (FCPD). We could not follow up the details of treatment, monitoring and progress, Rather we only focused on in-hospital mortality. We also did not follow up these patients following discharge from hospital for possible recurrence of DKA.

In conclusion, it can be said that DKA occurred most commonly among known diabetic patients. Common precipitating causes were infection and non-adherence to anti-diabetic treatment. It is assumed that proper patient education regarding importance of treatment adherence and sick days' management can prevent many episodes of DKA and thus can reduce morbidity and mortality of diabetic patients.

References :

1. Onyiriuka AN, Ifebi E. Ketoacidosis at diagnosis of type 1 diabetes in children and adolescents: frequency and clinical characteristics. J Diabet Metab Disa 2013;12:47.

2. Tan H, Zhou Y, Yu Y. Characteristics of diabetic ketoacidosis in Chinese adults and adolescents - a teaching hospital-based analysis. Diabetes Res Clin Pract 2012;97(2):306-12.

3. Al-Rubeaan KA, Aftab SA, Alotaibi MS, Alghamdi AA, Rafiullah MR. Clinico-laboratory characteristics of diabetic ketoacidosis in adults in tertiary hospital in Saudi Arabia. Eur Rev Med Pharmacol Sci 2011;15(10):1202-6.

4. Rahim MA, Uddin KN, Zaman S et al. Clinical spectrum and management of diabetic ketoacidosis: experience in a tertiary care hospital. Birdem Med J 2011;1(1):15-20.

5. Jabbar A, Farooqui K, Habib A, Islam N, Haque N, Akhter J. Clinical characteristics and outcome of diabetic ketoacidosis in Pakistani adults with type 2 diabetes mellitus. Diabet Med 2004;21(8):920-23.

6. Harzallah F, Ncini N, Alberti H et al. Clinical and metabolic characteristics of newly diagnosed diabetes patients: experience of a university hospital in Tunis. Diabetes Metab 2006;32(6):632-35.

7. Lone SW, Siddiqui EU, Muhammed F, Atta I, Ibrahim MN, Raza J. Frequency, clinical characteristics and outcome of diabetic ketoacidosis in children with type 1 diabetes at a tertiary care hospital. J Pak Med Assoc 2010;60(9):725-29.

8. Hardern RD, Quinn ND. Emergency management of diabetic ketoacidosis in adults. Emer Med J 2003;20(3);210-13.

9. Henriksen OM, Prahl JB, Roder ME, Svendsen OL. Treatment of diabetic ketoacidosis in adults in Denmark: a national survey. Diabetes Res Clin Pract 2007; 77(1):113-19.

10. Ko SH, Lee WY, Lee JH et al. Clinical characteristics of diabetic ketoacidosis in Korea over the past two decades. Diabet Med 2005;22(4):466-69.

11. KitabchiAE, Umpierrez GE, Miles JM, Fisher JN. Hyperglycaemic crises in adult patients with diabetes. Diabetes Care 2009;32(7):1335-43.

12. Mbugua PK, Otieno CF, Kayima JK, Amayo AA, McLigeyo SO. Diabetic ketoacidosis: clinical presentation and precipitating factors at Kenyatta National Hospital, Nairobi. East Afr Med J 2005;82(12 supl):s191-96.

13. Ahmed AU, Rahim MA, Rahman MR, Nazim RF, Uddin KN. Diabetic ketoacidosis: pattern of precipitating causes. J Enam Med Coll 2014;4(2):94-97.

14. Lin SF, Lin JD, Huang YY. Diabetic ketoacidosis: comparisons of patient characteristics, clinical presentations and outcomes today and 20 years ago. Chang Gunh Med J 2005;28 (1):24-30.

15. Orban J-C, Maiziere E-M, Ghaddab A, Obberghen EV, Ichai C. Incidence and characteristics of acute kidney injury in severe diabetic ketoacidosis. PLoS ONE 2014;9(10):e110925. (accessed April 1, 2015)

16. Mudly S, Rambiritch V, Mayet L. An identification of the risk factors implicated in diabetic ketoacidosis (DKA) in type 1 and type 2 diabetes mellitus. SA FamPract 2007;49(10):15.

17. Rao VD, Pradhan B, Mallikarjuna Y, Reddy R. Clinical profile of diabetic ketoacidosis in adults. Nepal Journal Online 2012;10(2):80-86.

18. Umpierrez GE, Kitabchi AE. Diabetic ketoacidosis: risk factors and management strategies. Treat Endocrinol 2003;2(2):95-108.

19. Pinto ME, Villena JE, Villena AE. Diabetic ketoacidosis in Peruvian patients with type 2 diabetes mellitus. Endocr Pract 2008;14(4):442-46.

20. Hossain MZ, Muhammad A, Azad KAK et al. Clinical characteristics of diabetic ketoacidosis in type 2 diabetes mellitus in Bangladeshi adult patients. J Dhaka Med Coll 2012;21(2):131-39.

21. Sharma V, Hadebe N. Diabetic ketoacidosis: principles of management. Br J Hosp Med (Lond) 2007;68(4):184-189.

22. Henriksen OM, Roder ME, Prahl JB, Svendsen OL. Diabetic ketoacidosis in Denmark: incidence and mortality from public health registries. Diabetes Res ClinPract 2007;76 (1):51-56.

23. Wagner A, Risse A, Brill HL, Wienhausen-Wilke V, Rottmann M, Sondem K. Therapy of severe diabetic ketoacidosis. Zero-mortality under very-low-dose insulin application. Diabetes Care 1999;22:674-677.

24. Ezeani I, Eregie O. Treatment outcome and prognostic indices in patients with hyperglycaemic emergencies. Diabetes Metab Syndr Obes 2013;6:303-07.