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Diabetic ketoacidosis in children: an 11-year retrospective in Surabaya, Indonesia

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Abstract

Background Diabetic ketoacidosis (DKA) is a complication of type I diabetic mellitus (T1DM). Early recognition and prompt treatment can reduce mortality.

Objective To evaluate the profiles of patients with diabetic ketoacidosis in Dr. Soetomo Hospital, Surabaya, Indonesia.

Methods Retrospective medical records of patients admitted to the pediatric intensive care unit with DKA in Dr. Soetomo Hospital, Surabaya, Indonesia from January 2002 to June 2013 were reviewed. The data collected included clinical parameters, laboratory and imaging results, predisposing factors, complications and outcomes.

Results During an 11 years period, there were 58 cases of DKA in children with T1DM. Eighteen subjects (31%) were boys. The severity of DKA was classified as follows: mild 13 (22.4%), moderate 23 (39.7%), and severe DKA 22 (37.9%). Recurrent DKA was diagnosed in 24 (41.4%) patients. Common clinical profiles recorded were dehydration 46 (79.3%), malaise 37 (63.8%), decreased consciousness 35 (60.3%), dyspnea 27 (46.6%), vomiting 26 (44.8%), fever 25 (43.1%), seizure 13 (22.4%), and decreased body weight 9 (15.5%). Laboratory results observed were as follows: hyponatremia 19 (32.8%), hyperkalemia 12 (20.7%) and acute renal failure 3 (5.2%). Head CT scans showed that 2 (3.4%) patients suffered from cerebral edema. Infections, as triggers of DKA, were found in 12 (20.6%) patients: 4 caries and periodontitis, 3 urinary tract infections, 2 acute diarrhea, 2 acute pharyngitis, and 1 otitis externa. Four out of 24 patients with recurrent DKA failed to take their insulin dose prior to DKA. The average of length of patient stay in the PICU was 3.26 (SD 3.50) days. No patients died during the study.

Conclusion Dehydration is the most common clinical profile of DKA in our study. More than half of the patients suffer from moderate to severe DKA. [Paediatr Indones. 2015;55:40-3.].

Keywords: children, diabetic ketoacidosis, clinical manifestations

Diabetic ketoacidosis (DKA) is one of the acute complications in type 1 diabetes mellitus (T1DM). It may be the first clinical manifestation observed. Diabetic ketoacidosis is the predominant cause of mortality in children with diabetes. An estimated 65,000 children under 15 year old develop the disease each year worldwide, and the global incidence in children continues to increase at a rate of 3% per year.^{1,2} Between 10 to 70% of these diagnosed children present as diabetic ketoacidosis cases.³

Early recognition and prompt treatment can substantially reduce mortality in children with T1DM. To the best of our knowledge, this is the first study reporting on clinical manifestations of DKA in Indonesia. We aimed to study the profiles of pediatric patients with DKA between year 2002-2013 in Dr. Soetomo Hospital, Surabaya, Indonesia.

Methods

Retrospective medical record reviews of patients admitted to the pediatric intensive care unit with

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DKA in Dr. Soetomo Hospital, Surabaya, Indonesia from January 2002-June 2013 were performed. We collected data on clinical parameters, laboratory and imaging results, predisposing factors, complications and outcomes. The current criteria for DKA diagnosis, published by the *International Society for Paediatric and Adolescent Diabetes*, are blood glucose >11 mmol/L, venous pH <7.3 or bicarbonate <15 mmol/L, and ketonemia and ketonuria. The severity of DKA was categorized by the degree of acidosis as follows: mild: venous pH <7.3 or bicarbonate <15 mmol/L, moderate: pH <7.2, bicarbonate <10 mmol/L, or severe: pH <7.1, bicarbonate <5 mmol/L.³

Results

There were 58 DKA cases in children with T1DM during the study period. Characteristics of patients are shown in **Table 1**. Clinical manifestations of DKA are presented in **Figure 1**.

Common clinical profiles recorded were dehydration 46 (79.3%), malaise 37 (63.8%), decreased con-

sciousness 35 (60.3%), dyspnea 27 (46.6%), vomiting 26 (44.8%), fever 25 (43.1%), seizure 13 (22.4%), and decreased body weight 9 (15.5%).

We observed the following laboratory results: hyponatremia 19 (32.8%), hyperkalemia 12 (20.7%) and acute renal failure 3 (5.2%). Two (3.4%) patients had cerebral edema on head CT scan. There were 12 (20.6%) patients with infections during the study, confirmed by clinical manifestations, complete blood counts and blood cultures (**Figure 2**).

Of the subjects with recurrent DKA, 4/24 patients failed to take their insulin days before their DKA episodes. Mean length of patient stay in the

Table 1. Characteristics of the subjects

Characteristics	n (%)
Male gender	18 (31)
DKA classification	
Mild	13 (22.4)
Moderate	23 (39.7)
Severe	22 (37.9)
Recurrent DKA	24 (41.4)
First DKA manifestation	34 (58.6)

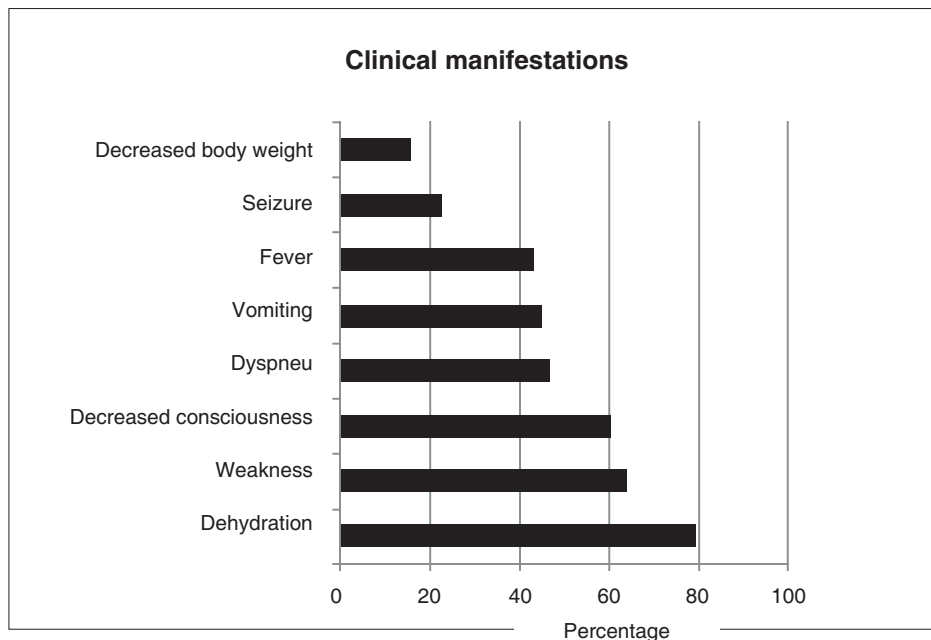


Figure 1. Percentage of clinical manifestations of DKA in Dr. Soetomo Hospital

PICU was 3.26 (SD 3.50) days. No patients died during the study.

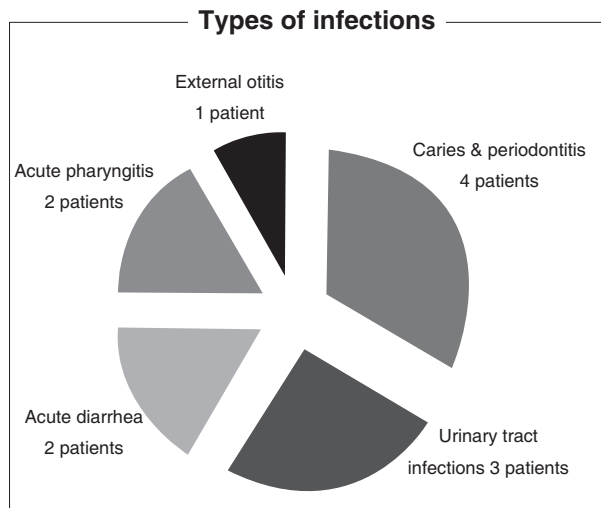


Figure 2. Types of infections as DKA triggers

Discussion

More than half of the subjects experienced DKA as their first clinical manifestation of T1DM. In contrast, a study stated that approximately one-third of newly-diagnosed T1DM patients presented with DKA.⁴ In Europe and North America, this figure ranged from approximately 15 to 70%.⁵⁻⁹ It remains unknown why some children present in DKA and whether the development of diabetic ketoacidosis is a consequence of delayed diagnosis and treatment or whether it reflects a particularly aggressive form of diabetes.¹⁰

In our study, 39.7% and 37.9% of patients suffered from moderate and severe DKA, respectively. Other studies reported that mild DKA was more frequent than moderate and severe. Klingensmith *et al.* reported 17% subjects with moderate or severe DKA, while Oyarzabal *et al.* found that moderate and severe forms were 34.4% and 17.8%, respectively.^{4,11}

Boys comprised 31% of our subjects. Usher-Smith JA *et al.* reported that of 21 studies on the effect of gender on DKA frequency, 20 found no effect, while 1 study by Neu *et al.* (n=2,121) reported a small but statistically significant increase in DKA frequency in girls in 2003.^{12,13}

The most common clinical manifestation

observed was dehydration, consistent with finding in earlier study.¹⁴ Other clinical manifestations included weakness, decreased consciousness, dyspnea, vomiting, fever, seizures, and decreased body weight. Similarly, another study stated that DKA often presented abdominal pain,^{15,16} weakness,¹⁶ changes in mental status,^{14,16,18} dyspnea,¹⁷ vomiting,¹⁵⁻¹⁷ and anorexia.¹⁶ Two studies also showed that children with DKA had significantly greater weight loss than those without.¹⁴⁻¹⁶ A study reported that classic triad (polyuria, polydipsia, and weight loss) had the highest percentage in DKA,¹⁸ meanwhile another study reported polydipsia, polyuria, weakness, and abdominal pain were the commonest symptoms observed.¹⁹

Hyponatremia, hyperkalemia and acute renal failure were improved after rehydration, insulin treatment and serum electrolyte correction. Poovazaghi *et al.* found that 11.5% of DKA patients had renal failure. Sepsis and shock were the common etiological factors. Mortality due to acute renal failure (ARF) in DKA was 40%.²⁰

Twelve (20.6%) patients suffered from infection during the study. Poovazaghi reported that infections were often the precipitating factors in DKA, as observed in 47% of his cases.²¹ History of infection or febrile illness was associated with an increased risk of DKA [odds ratios 6.50 (2.06 to 20.53) and 1.87 (1.05 to 3.33)].¹³ In our subjects, 6.9% failed to take their insulin among the ones with established T1DM, compared to 28% with poor compliance in the Poovazaghi study in India.²¹ Length of patient PICU stay was 3.26 (SD 3.50) days, longer than that in India which was about 1.94 days.²¹ No patients died during our study. However, Poovazaghi reported the mortality in established DKA and in new cases to be 7.1% and 12.7%, respectively.²¹

In conclusion, physicians must be aware that diabetic ketoacidosis may be the first clinical manifestation observed in T1DM. Increased awareness of T1DM in the medical and lay communities is needed to decrease the incidence of life-threatening complications.

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