

# Diabetic ketoacidosis as first presentation of type 1 diabetes mellitus in a young child

## Important differential diagnosis for respiratory distress

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**D**iabetic ketoacidosis (DKA) is a life-threatening complication of hyperglycemia in patients with type 1 diabetes mellitus (T1DM). As a first presentation, overlapping signs of DKA and the respiratory infections that can trigger DKA, especially during cold and flu seasons, can complicate this diagnosis. Kussmaul breathing, characterized by tachypnea and increased depth of breath, is a classic sign of DKA; however, change in depth of breathing might not be apparent in younger children owing to their size. This case describes a toddler in respiratory distress, attending her primary care clinic with a 1-week history of upper respiratory tract symptoms. For family physicians, it is important to keep a differential diagnosis for respiratory distress in mind. If the examination is not consistent with more common presentations, then other causes should be considered.

### Case

A 22-month-old girl presented with her mother to the family doctor's office for worsening dyspnea. Her mother described hearing a "barky" cough and reported symptoms consistent with a viral prodrome in the past week. She also had older siblings at home with upper respiratory tract infections. On examination she was tachypneic, using her accessory muscles to breathe, and was grunting. Auscultation of her chest revealed good air entry bilaterally with no adventitious sounds, and her oxygen saturation was normal. However, during the examination, despite receiving oxygen by facial mask and several doses of salbutamol, she became progressively lethargic. Therefore, emergency medical services transferred her to the emergency department with a provisional diagnosis of croup based on her initial clinical presentation and rapid clinical decline in the office. In the emergency department, results of bloodwork requested owing to her decreased level of consciousness revealed that she was profoundly hyperglycemic and she was treated according to the pediatric DKA protocol. She was admitted with a new diagnosis of T1DM and was referred for ongoing diabetes management.

### Differential diagnosis

There are many differential diagnoses for Kussmaul breathing. In the context of T1DM, Kussmaul breathing is the result of metabolic acidosis. A focused differential diagnosis pertinent to the pediatric population should consider disorders from other systems (**Box 1**).

### Discussion

Type 1 diabetes mellitus is a common chronic condition in childhood. The age of onset for childhood T1DM has a bimodal distribution: one peak at 4 to 6 years of age and a second peak in early puberty (10 to 14 years of age).<sup>1</sup> In the United States, the incidence of T1DM in non-Hispanic white children is quoted to be 23.6 per 100 000 per year.<sup>2</sup> Among the provinces in Canada, incidence ranges from 36 per 100 000 in Newfoundland and Labrador<sup>3</sup> to

### Editor's key points

- ▶ Diabetic ketoacidosis (DKA) is a common presentation of type 1 diabetes mellitus in children younger than 3 years of age.
- ▶ Kussmaul breathing, characterized by tachypnea and increased depth of breath in response to metabolic acidosis, is a less common first presentation of DKA.
- ▶ During cold and flu season, DKA can be harder to identify because Kussmaul breathing might be mistaken as a sign of respiratory infection.
- ▶ Assessing for polyuria and polydipsia and performing point-of-care glucose and ketone testing in young children presenting with respiratory symptoms could help family physicians consider DKA and type 1 diabetes mellitus as potential diagnoses.

### Box 1. Differential diagnoses for Kussmaul breathing in young children

#### Cardiac

- Heart failure
- Cardiogenic shock

#### Respiratory

- Infection—pneumonia, croup, bronchiolitis
- Uncontrolled asthma
- Upper airway obstruction (eg, foreign body)

#### Metabolic and endocrine

- Acidosis—MUDPILES (methanol, uremia, diabetic ketoacidosis, propylene glycol, paraldehyde, iron, isoniazid, lactic acidosis, ethylene glycol, salicylate drugs [eg, alcohol, ingested poisons, acetylsalicylic acid])
- Renal failure
- Inborn errors of metabolism
- Hyperthyroidism

#### Neurologic and psychological

- Intracranial pathology with increased intracranial pressure (eg, space-occupying lesion, bleeding, cerebral edema)
- Substantial head trauma
- Anxiety

#### Other


- Sepsis

15 per 100 000 in Quebec.<sup>4</sup> A stressor (such as infection) on top of poor glycemic control can result in DKA.

The reported frequency of DKA as the first presentation of childhood T1DM ranges from 15% to 67% in various studies.<sup>5</sup> More meaningfully, more than half of children younger than 3 years of age present with DKA as their first presentation of T1DM.<sup>5</sup> Presenting symptoms of DKA include polyuria and polydipsia, weight loss, fatigue, altered mental status, and respiratory distress (ie, Kussmaul breathing).<sup>6</sup> While polyuria and polydipsia frequently occur, Kussmaul breathing occurs in only 28% of DKA presentations.<sup>7</sup> In addition to physiologic stressors, other risk factors for developing DKA include female sex, no family predisposition, African American race, a younger age (<5 years old), and other social factors including low socioeconomic status, limited access to medical services, and unstable family circumstances.<sup>5,8,9</sup>

A 2016 case study reported a 7-week-old infant with DKA presenting to the emergency department with fever, altered mental status, and respiratory distress. In this situation, the workup included a capillary blood glucose reading and investigations into sources of infection.<sup>10</sup> This case study is consistent with reports that a preceding febrile illness is observed in 40% of DKA cases.<sup>6</sup>

### Conclusion

Our young patient presented with a viral prodrome and previous symptoms consistent with croup; however, the physical examination findings did not match the medical history. This case highlights the need for family physicians to be vigilant when past symptoms and the clinical examination appear discordant. During cold and flu season, family physicians might be lured into making an early diagnosis of respiratory infection in patients presenting with respiratory symptoms. Important yet simple questions probing for polyuria and polydipsia should be asked in young children presenting with respiratory issues to help identify whether DKA is a diagnostic consideration. Finally, consider performing point-of-care capillary blood glucose testing in children presenting with symptoms of respiratory distress and reduced level of consciousness to assess for DKA. Ketones can also be measured through urine dips or point-of-care capillary devices to support the diagnosis. 

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#### Competing interests

None declared

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