COVID-19 and Diabetic Ketoacidosis in a Child: A Case Report

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Abstract

Since the World Health Organization (WHO) announced the severe acute respiratory syndrome coronavirus 2 pandemic, different cases with various diseases have been reported along with the coronavirus disease 2019 (COVID-19). Although COVID-19 is less common among children than adults, herein we reported an 11-year-old child who was referred to the emergency room of our hospital with tachypnea and a decreased level of consciousness (GCS: 11-15), along with vomiting and abdominal pain as the first manifestations of type 1 diabetes. She had a 2-week history of polydipsia, polyuria, and nocturia and experienced a weight loss of 5 kg during the past month. The result of the real-time polymerase chain reaction for COVID-19 was turned out to be positive. The computed tomography scan of the lung revealed subpleural ground-glass opacities that were compatible with COVID-19. Although it was found that diabetic ketoacidosis (DKA) is precipitated by various viral infections, it informs us once again that during this pandemic, there should be a high suspicion and awareness of COVID-19 infection in patients with DKA.

Background

Since the emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease 2019 (COVID-19), various manifestations and symptoms have been reported in different age groups. Accordingly, about 1-5% of all the confirmed cases were children, and fortunately, they normally had milder diseases, better outcomes, and lower mortality rates compared to adults. The most common comorbidities in children are asthma, immunodeficiency disorders, and cardiovascular disease.1,3 Despite many studies performed on COVID-19, the epidemiological evidence and prognosis of diabetes mellitus type 1, especially ketoacidosis, have not been extensively studied yet. Therefore, there is no confirmed evidence of their higher incidence compared to children without COVID-19.4

In the present study, we reported an 11-year-old girl with new-onset diabetes mellitus who developed diabetic ketoacidosis (DKA) and cerebral edema and was diagnosed with COVID-19 infection.

Case Report

An 11-year-old girl was admitted to the emergency room with tachypnea and a decreased level of consciousness. She was highly drowsy (GCS: 11-15) and could wake up with painful stimulation. Moreover, she had a 2-week history of polydipsia, polyuria, and nocturia and experienced a weight loss of 5 kg during the past month. This patient also had vomiting and abdominal pain one-day before the admission. It should be noted that she was born from unrelated parents at 38 weeks of gestational age, with a birth weight and length of 3.4 kg and 50 cm, respectively. Apart from this new situation, this patient had no history of hospitalization, no medications, no exposure to drugs, alcohol, or any harmful chemicals, as well as no history of diabetes mellitus in her family. Upon examination, her Kussmaul respiration was checked, and she was stuporous, tachypneic, and tachycardic. Notably, her body temperature, blood pressure, heart rate, respiratory rate, and oxygen saturation were 37°C, 85/60 mm Hg, 150 beats/minute, 45 per minute, and 89% by pulse oximetry at room air, respectively. In addition, her height and weight were 148 cm and 43 kg, respectively, with a body mass index of 19.6 kg/m². The patient’s initial random blood glucose (480 mg/dL), arterial pH (6.8), bicarbonate 3 mmol/L, and positive urine dipstick test for glucose and ketones demonstrated all the diagnostic criteria for DKA. After receiving the first-hour fluid in the emergency department, the patient underwent insulin drip at a rate of 0.1 kg/min and was then transferred to the pediatric intensive care unit.

A few hours after the admission, the patient developed hypertension, bradycardia, and headache and received mannitol following the onset of double mydriasis with...
a diagnosis of cerebral edema. Subsequently, she was intubated and connected to the ventilator following respiratory acidosis.

Further investigations revealed a normal liver function test, lipid profile, Ca, K, and P; however, she was hypernatremic. In addition, the pancreatic islet cell autoantibodies and glutamic acid decarboxylase autoantibody were positive.

As indicated by Table 1, patients’ white blood cell count, polymorphonuclear, and lymphocyte were 27000/μL, 64.8%, and 25.3%, respectively. Further, both blood culture and urine culture were negative.

According to the general condition of this patient, the result of the real-time polymerase chain reaction for COVID-19 was positive. Moreover, the CT scan of the lung revealed subpleural ground-glass opacities that were compatible with COVID-19 (Figure 1).

According to this diagnosis, at that time, atazanavir/ritonavir plus cefotaxime were prescribed in terms of our hospital protocol for COVID-19.

Two days after the admission, the DKA of the patient was resolved, and she was then referred to the pediatric ward with a subcutaneous insulin regimen on the third hospitalization day. Finally, the patient was discharged with the insulin regimen when she had no fever and dyspnea.

**Discussion**

The incidence of type 1 diabetes mellitus (T1DM) varies in different geographical regions in the world. Further, environmental factors, other biological factors (e.g., age, gender, and race), and family history play important roles in its occurrence. The highest incidence rate was found in Finland as 65 per 100 000 in children under the age of 15. The most common symptoms of T1DM in children are polyuria, polydipsia, and weight loss. Moreover, another common manifestation that is considered as the first sign of hospitalization is DKA. The prevalence rate of DKA as an early sign of T1DM varies from 30% to 34% in children. Coxsackievirus type B is one of the most widely suspected environmental factors in the development of T1DM.

In the present study, we reported an 11-year-old girl with DKA diagnosed with COVID-19 infection as her first manifestation of diabetes, and she was discharged in good general status 10 days later. Most children with COVID-19 have less severity and better prognosis compared to adults. The disease in children may be asymptomatic, along with fever and respiratory or gastrointestinal manifestations. Some manifestations of COVID-19 (e.g., nausea, vomiting, fatigue, abdominal pain, and abdominal breathing) may overlap with symptoms known for DKA. It may also stimulate and worsen metabolic diseases like diabetes in children.

After the diagnosis, the infection was treated, and the patient responded well to the treatment in a short time in spite of the high severity of the initial manifestations. Therefore, we were able to control ketoacidosis in the patient along with controlling COVID-19.

| Parameter                  | The First Day of Admission | Reference Values |
|----------------------------|---------------------------|------------------|
| WBC                        | 27000 mm$^3$              | 4000-10000/mm$^3$|
| Platelets                  | 347×10$^3$/L              | 150000-450000/mm$^3$|
| Blood sugar                | 462 mg/dL                 | 70-100 mg/dL     |
| Glycosylated hemoglobin HbA1c | 11.27%                   | 4.5-5.7%         |
| CRP quantitative           | 2 mg/L                    | > 10 mg/L        |
| ESR                        | 2 mm/h                    | 0-15 mm/h        |
| Cholesterol                | 120 mg/dL                 | > 170 mg/dL      |
| Triglyceride               | 100 mg/dL                 | 40-140 mg/dL     |
| Serum Na                   | 154 mmol/L                | 135-145 mmol/L   |
| LDH                        | 1320 U/L                  | 110-295 U/L      |
| D-DIMER                    | 2.4 μg/ml                 | < 1 μg/ml        |
| Prothrombin time           | 13.2 s                    | 12-14 s          |
| PTT                        | 24.1 s                    | 20-40 s          |
| INR                        | 1                         | 1-1.2            |
| Fibrinogen                 | 313 mg/dL                 | 212-433 mg/dL    |
| ABG                        | pH 6.8                    | 7.35-7.45        |
|                            | PCO$_2$, 21.9 mm Hg       | 35-40 mm Hg      |
|                            | HCO$_3$, 3.3 mEq/L        | 22-26 mEq/L      |
| Urine analysis             | 3+                        |                  |
| Ketone                     | 3+                        |                  |
| Glucose                    | 2+                        |                  |
| Protein                    | 4-6                       |                  |
| WBC                        | 10-15                     |                  |
| RBC                        | -                         |                  |
| BUN                        | 15 mg/dL                  | 10-36 mg/dL      |
| Creatinine                 | 2.08 mg/dL                | 0.3-0.7 mg/dL    |
| Ferritine                  | 1701 ng/mL                | 7.140 mg/mL      |
| Troponine                  | Negative                  |                  |

**Note.** CRP: C-reactive protein; ESR: Erythrocyte sedimentation rate; Serum Na: Serum sodium; LDH: Lactate dehydrogenase; PTT: Partial thromboplastin time; INR: International normalized ratio; ABG: Arterial blood gas; WBC: White blood cell; RBC: Red blood cell; BUN: Blood urea nitrogen.
The first manifestation of diabetes in this patient was DKA in association with COVID-19. During the current pandemic of this disease, we should consider COVID-19 in any child with DKA, especially with unusual presentations, and the necessary examination should be performed.

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Conflict of Interest Disclosures
The authors declare no conflicts of interests regarding this work.

Ethical Approval
Written informed consent was obtained from parents of the patient for publication of this report.

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