

CASE REPORT

Diabetic ketoacidosis mimicking COVID-19 in an adolescent

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Abstract

Diabetic ketoacidosis (DKA) may be associated with nonspecific symptoms such as dyspnea, tachycardia, anorexia, and vomiting that are similar to COVID-19. We describe an adolescent who was referred to the emergency department with the above symptoms and died after being discharged, regardless of the differential diagnosis and laboratory findings.

KEYWORDS

COVID-19, diabetic ketoacidosis, dyspnea

1 | INTRODUCTION

Coronaviruses are among the most important human pathogens. In late 2019, a new variant of the coronavirus was discovered in Wuhan (Hubei Province, China) as the cause of pneumonia. This new member of the coronavirus family was named COVID-19.¹ Regardless of age, each individual faces the risk of infection with COVID-19.² The severity of this infection can be asymptomatic, mild, moderate, or severe.³

COVID-19 infection may occur with various clinical symptoms. The most common symptoms of this disease include fever, chills, cough, muscle pain, dyspnea, headache, loss of appetite, and gastrointestinal symptoms (such as abdominal pain, nausea, and vomiting).^{4,5}

Asymptomatic infection can only be detected through virological tests and polymerase chain reaction (PCR). In mild cases, nonspecific symptoms such as fever and cough are present, but are not associated with dyspnea, and there is no evidence indicating the COVID-19 in the CT scans. In moderate infections, nonspecific symptoms are frequently accompanied by imaging evidence and respiratory symptoms (such as dyspnea).⁶

Diabetic ketoacidosis (DKA) is one of the most extreme conditions caused by type 1 diabetes and, with less severity, by type 2 diabetes. Ketoacidosis and hyperglycemia are the indicators of DKA.⁷ The incidence of DKA is a common manifestation among undiagnosed type 1 diabetes patients. Infections (primarily pneumonia or urinary tract infections), discontinuation of insulin therapy, or

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insufficient insulin in diabetic patients can all contribute to DKA.⁸

DKA may be associated with unspecific symptoms, including dyspnea, tachycardia, loss of appetite, nausea, and vomiting.⁹ Several nonspecific symptoms of DKA may be similar to COVID-19 symptoms (especially among undiagnosed adolescents with type 1 diabetes). Due to the current COVID-19 pandemic, knowing the difference between COVID-19 and other diseases that share the symptoms is of great importance. We describe the case of an adolescent boy who was referred to the emergency department (ED) with dyspnea and was discharged after performing a chest X-ray with a diagnosis of COVID-19; however, he died regardless of the differential diagnosis of dyspnea and laboratory findings.

2 | CASE PRESENTATION

On April 12, 2021, a 16-year-old adolescent boy, a student without a family history of an underlying disease, was referred to the hospital emergency department (ED) in northern Iran with a chief complaint of dyspnea. His dyspnea had become intense from the previous day. The patient had no known underlying diseases, and neither of his parents had any medical or illness history. The primary vital signs of the patient were stable, and tachycardia and tachypnea were not present. Laboratory findings are shown in Table 1. Due to the COVID-19 pandemic and the onset of the second peak in Iran, considering the incidence

of dyspnea and laboratory data reports such as leukocytosis and elevated C-reactive protein (CRP), the possible primary diagnosis was COVID-19. Also, PCR sampling was performed for fast confirmation of diagnosis, and a lung computed tomography (CT) scan was requested. Before the PCR test result answer was ready, he was discharged with prescription drugs such as hydrocortisone ampoules (100 mg), adult cold tablets, and diphenhydramine syrup. He was asked to return to the hospital in case of a recurrence of the respiratory symptoms.

The following morning, the patient was referred to the ED again with complaints including dyspnea and restlessness. The primary vital signs of the patient were as follows: The blood pressure is 120/75 mmHg, the temperature is 37°C, the heart rate is 130 beats/minute, the respiratory rate is 24 breaths/minute, and oxygen saturation is 98%. Considering the vital signs of the patient, he had tachycardia and restlessness. Therefore, an electrocardiogram (ECG) was requested. Due to the severity of the restlessness, the patient did not cooperate with the ECG test. As well, we measured the blood sugar with a glucometer, and the result was reported as 403 mg/dL. The medical history of the patient was obtained through certain questions and a comprehensive history. The patient's mother mentioned that her son had polyuria and polydipsia symptoms in the last ten days. She also stated that the patient had recently lost 10 kg of body weight. Because of the hyperglycemia (blood sugar level of 403 mg/dL) and the symptoms that were suggestive of diabetes, urea, Cr, K, Na, Ca, Mg, Alb, BS, ABG, and

Laboratory data parameter	Result	Normal Range
WBC	$16 \times 10^3/\text{mm}^3$	$4\text{--}1010^3/\text{mm}^3$
PLT	$265 \times 10^3/\text{mm}^3$	$145\text{--}450 \times 10^3/\text{mm}^3$
Neutrophils	$12340/\text{mm}^3$	$2500\text{--}8000/\text{mm}^3$
Lymphocytes	$1360/\text{mm}^3(12\%)$	$1000\text{--}4000/\text{mm}^3$
Hb	13 g/dl	12.3–15.3 g/dL
BS	260 mg/dL	90–110 mg/dL
Urea	38 mg/dL	13–40 mg/dl
Cr	1.3 mg/dL	0.5–1.3 mg/dL
K	3.7 mEq/L	3.5–5.5 mEq/L
Na	136 mEq/L	135–145 mEq/L
C.R.P	10^+ mg/L	Less than 6 mg/L
ESR	12mm/hr	0–20 mm/hr
LDH	295 U/L	140–280 U/L
Troponin Q	10 ng/dl	Less than 100 ng/dl
pH	7.30	7.35–7.45
PCO ₂	25.4 mmHg	35–45 mmHg
HCO ₃	13mEq/L	22–28 mEq/L

TABLE 1 Initial laboratory data in emergency department

TABLE 2 Laboratory data in the ICU

Laboratory data parameter	Result	Normal Range
WBC	$14 \times 10^3/\text{mm}^3$	$4\text{--}10 \times 10^3/\text{mm}^3$
PLT	$265 \times 10^3/\text{mm}^3$	$145\text{--}450 \times 10^3/\text{mm}^3$
Neutrophils	$11340/\text{mm}^3$	$2500\text{--}8000/\text{mm}^3$
Lymphocytes	$1260/\text{mm}^3(9\%)$	$1000\text{--}4000/\text{mm}^3$
Hb	14 g/dl	12.3–15.3 g/dL
BS	403 mg/dL	90–110 mg/dL
Urea	45 mg/dL	13–40 mg/dl
Cr	1.4 mg/dL	0.5–1.3 mg/dL
K	3.5 mEq/L	3.5–5.5 mEq/L
Na	130mEq/L	135–145 mEq/L
Calcium	9.5 mg/dl	8.5–10.5 mg/dl
Mg	1.9 mg/dl	1.8–2.2 mg/dl
Albumin	4 g/dl	3.5–5.5 g/dl
P	3.1 mg/dl	2.5–4.5 mg/dL
C.R.P	3 ⁺ mg/L	Less than 6 mg/L
ESR	15 mm/hr	0–20 mm/hr
LDH	334 U/L	140–280 U/L
pH	6.41	7.35–7.45
PCO ₂	20.4 mmHg	35–45 mmHg
HCO ₃	4.1 mEq/L	22–28 mEq/L

Abbreviations: BS, Blood sugar; Cr, Creatinine; CRP, C-reactive protein; ESR, Erythrocyte Sedimentation Rate; Hb, Hemoglobin; LDH, Lactate dehydrogenase; PLT, Platelet count; WBC, White blood cells.

ketone body tests were requested. The ABG test result indicated severe metabolic acidosis (Table 2). As a result, DKA was diagnosed, and the patient was transferred to the intensive care unit (ICU).

In the ICU, the patient underwent routine treatment for DKA. The medication included serum N/S (1000 cc), 10 cc KCL 15%, amp ceftriaxone 1 gr BD, insulin regular 5 IU stat, and then 2 IU/h. Due to ABG disorder and decreased consciousness level, anesthesia consultation was also requested. According to the anesthesiologist, the patient did not require mechanical ventilation support, and two vials of bicarbonate were added to his medication. At the next step, cardiovascular counseling was requested. According to the cardiologist's opinion, the patient had no heart complications, and routine DKA management was continued. After 24 h, the PCR test for COVID-19 was negative. Unfortunately, despite appropriate treatment, the patient's respiratory condition and level of consciousness decreased, and he was intubated, followed by cardiopulmonary arrest, and died after six days. Written informed consent was obtained from the patient's parents for publication of this report. This study was conducted according to the Declaration of Helsinki Principles. Also, CARE guidelines and methodology have been followed in this study.

3 | DISCUSSION

We mentioned a patient who came to the ED with dyspnea complaints. Considering the current pandemic, he was first diagnosed with COVID-19 and treated as an outpatient. The following day, he returned to the hospital and reported tachycardia and severe dyspnea. According to the accurate medical history obtained, he was diagnosed with diabetic ketoacidosis. The patient was transferred to the ICU, but unfortunately, he died after six days.

DKA is the main cause of death among children and adolescents with type 1 diabetes. This condition occurs with a type 1 diabetes diagnosis in almost one-third of the children in the United States.¹⁰ Ketoacidosis is highly lethal for undiagnosed diabetes patients and can be associated with symptoms including polyuria, polydipsia, loss of appetite, nausea, vomiting, abdominal pain, dyspnea, tachycardia, tachypnea, and eventually coma and death.¹¹

- If the patient has all of the following findings, then the diagnosis of DKA is confirmed^{12,13}:
- Blood sugar levels greater than 200 mg/dL (normally, serum glucose concentrations are less than 800 mg/dL and range between 350 and 500 mg/dL)

- The incidence of metabolic acidosis (pH of venous blood less than 7.3 or bicarbonate less than 15 mmol/L)
- The presence of ketone bodies in the blood or urine.

However, metabolic acidosis is usually the most important finding related to DKA. Our patient indicated all of the mentioned findings (Table 2).

Dyspnea was the main clinical complaint of our patient. Dyspnea is a common symptom of ketoacidosis and COVID-19 infection.¹⁴ In DKA, the body compensates for the metabolic acidosis through hyperventilation and diaphragmatic breathing. This condition is first revealed by an increase in the depth of breath and tachypnea. However, lack of proper medical measures can lead to respiratory muscle fatigue, inadequate ventilation, CO₂ retention, and dyspnea.¹⁵ On the other hand, dyspnea is a common finding among COVID-19 patients. Fever, cough, and dyspnea were the most common symptoms of COVID-19 patients when they arrived at hospitals, according to various studies.¹⁶

Restlessness and tachycardia were other key findings in our patient. Due to free water loss in DKA, intravascular volume is decreased. Therefore, clinical symptoms linked to intravascular volume decrease, such as tachycardia, poor perfusion of peripheral organs, and poor skin turgor, are common among DKA patients.¹⁷ Such symptoms may overlap with symptoms of other diseases. On the other hand, tachycardia (caused by stress or other factors) and restlessness may also happen in COVID-19, especially at the early stages of infection.¹⁸

Another reason for our patient's misdiagnosis was the similarity of some of the laboratory findings between COVID-19 and DKA. Our patient had leukocytosis and an increase in C-reactive protein (CRP) and lactate dehydrogenase (LDH) levels on the first visit to the ED (Table 1). Laboratory findings in patients with COVID-19 may differ. In the complete blood count analysis, leukopenia, leukocytosis, and lymphocytopenia have been reported, although the most common manifestation is lymphocytopenia. Also, increased CRP, erythrocyte sedimentation rate (ESR), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and LDH can occur.¹⁹ The majority of DKA patients have leukocytosis, pro-inflammatory cytokine production, and an increase in CRP. This condition is proportional to the degree of ketonemia, is unrelated to infection, and can be caused by an increase in catecholamine.²⁰

Due to the high number of referrals to the hospital's ED as a result of the COVID-19 pandemic and the medical centers' overload, inability to obtain a complete medical history may occur, resulting in inaccurate evaluation and misdiagnosis. In some cases, misdiagnosis may lead to

severe complications or even death. Generally, COVID-19 is associated with multiple nonspecific signs and symptoms. These findings may overlap with other diseases. To confirm the diagnosis of COVID-19, the complete clinical and laboratory conditions must be considered.²¹ In addition to the clinical manifestations and regular laboratory tests, the PCR test is still the best diagnostic option. Eventually, the patient's fate reveals that the clinicians must avoid overreacting to COVID-19, and besides carefully evaluating the patient's condition, they should also consider the overlapping similar laboratory data, signs, and symptoms of various diseases.

4 | CONCLUSION

Because there are several differential diagnoses for a symptom, a comprehensive history of the patient is required for an accurate diagnosis at the time of admission. Physicians should be aware of the differential diagnosis to avoid misdiagnosis or over-diagnosis. Consequently, DKA should be considered in the COVID-19 differential diagnosis, particularly in children, adolescents, and uncontrolled diabetic mellitus patients. Therefore, obtaining an accurate history and urgent approach is essential for appropriate patient management.

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CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

AUTHORSHIPS

SJB and ZZ were involved in the interpretation and collecting of data and editing of the manuscript. ASH and ESB were involved in writing and preparing the final version of the manuscript. MS was responsible for submitting the manuscript. All authors reviewed the paper and approved the final version of the manuscript.

ETHICAL APPROVAL

The study was approved by our local ethics committee.

CONSENT

Written informed consent was obtained from the patient's parents for publication of this report.

DATA AVAILABILITY STATEMENT

The data are available with the correspondence author and can be achieved on request.

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