

Case Report

Fatal Outcome of Acute Mesenteric Ischaemia Associated with Diabetic Ketoacidosis in a Child During the COVID-19 Pandemic: A Case Report

DS PARK, YS LEE, EY JOO, JE LEE

Abstract

Background: The fear of coronavirus disease-2019 (COVID-19) and long-term social isolation measures has led to unintended consequences, including delayed diagnosis and treatment of diabetes mellitus (DM), and increasing incidence of diabetic ketoacidosis (DKA). Acute mesenteric ischaemia (AMI) is a rare, but rapidly serious abdominal process associated with DKA. We report a fatal paediatric case who presented with DKA associated with rapidly deteriorating AMI during the pandemic period. The patient delayed medical care during the pandemic due to concerns about COVID-19. **Case Presentation:** A previously healthy 13-year-old girl presented to the emergency department with vomiting, lethargy, polyuria, polydipsia, and weight loss. She was newly diagnosed with DM complicated with severe DKA. Despite intensive fluid and insulin therapy, her condition deteriorated rapidly, and she was identified as having extensive pneumatosis intestinalis suggestive of gangrenous bowel perforation caused by acute mesenteric ischaemia. The patient subsequently could not be resuscitated. **Conclusion:** AMI should be initially suspected in patients with severe DKA, even having a soft abdomen in childhood DKA. Increased awareness of pediatric DKA can prevent delays in medical care for early diagnosis of AMI.

Key words

Acute Mesenteric Ischaemia; Diabetic Ketoacidosis; Child; COVID-19

Introduction

Coronavirus disease-2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2, has rapidly spread worldwide to become the most significant health issue in 2020.¹ The public's fear of COVID-19 has been intensified by the introduction of various measures that result in social isolation, such as quarantines, stay-at-home orders, and the closure of non-essential businesses.² However, this policy has led to unintended consequences,

including the delayed presentation of paediatric diseases, which impedes prompt diagnosis and treatment.³

Diabetic ketoacidosis (DKA) is a common serious life-threatening acute complication of diabetes mellitus (DM) which may be accompanied by fatal acute complications. Acute mesenteric ischaemia (AMI) is the less common, but rapidly worsening vascular emergency as one of the complications of DKA.⁴ This association has been mostly described among elderly patients,⁵ but rarely in paediatric patients.

Herein, we present a rare case of new-onset paediatric diabetes complicated by DKA and rapidly deteriorating AMI. Unfortunately, the patient delayed medical care during the pandemic because of concerns about COVID-19.

Department of Pediatrics, Inha University Hospital, Inha University College of Medicine, Incheon, South Korea 27 Inhang-ro, Jung-gu, Incheon, South Korea 22332

DS PARK MD
YS LEE MD
EY JOO MD
JE LEE MD, PhD

Case Presentation

A 13-year-old previously healthy girl was admitted to the emergency department because of a 3-day history of vomiting and progressive lethargy. She had a 1-month

Correspondence to: Dr JE LEE
Email: anicca@inha.ac.kr

Received June 30, 2023

history of polyuria, polydipsia, and a weight loss of 13 kg over 1 month. She daily consumed sugar-rich beverages to quench her thirst. Although over the past month, the patient suffered frequent episodes of vomiting with abdominal pain, she avoided medical care because of concerns about COVID-19. On admission, the patient presented with pale skin, deep labored breaths, and an altered state of consciousness (GCS 11) without focal neurological deficits. Her height was 158 cm (25th<p<50th) and weight was 41 kg (10th<p<25th). Initial vitals were as follows: a heart rate of 130 beats/min, respiratory rate of 28 breaths/min, blood pressure of 98/50 mmHg, temperature of 37.0°C, and O₂ saturation of 99% on room air. Her physical examination was unremarkable, except for severe dehydration. Her abdomen was soft, non-tender, and slightly distended with hypoactive bowel sounds on examination. A plain X-ray revealed mild paralytic ileus (Figure 1). Laboratory findings were consistent with DKA. She showed severe hyperglycemia (blood glucose 1,330 mg/dL (73.9 mmol/L)), high anion gap (48 mmol/L) with acidosis of pH 7.15, high ketone levels, and hyperosmolar state (Table 1). CT scan of the brain excluded cerebral oedema. She was transferred to the intensive care unit (ICU) for managing DKA. After initial fluid resuscitation with 2 L of normal saline, a continuous insulin infusion was begun. The patient was rehydrated via fluid therapy on the basis of a calculated free water deficit. Over the 10 hours of intensive fluid resuscitation and adequate insulin infusion therapy, despite decreases in blood glucose level of 60 mg/dL (3.3 mmol/L)/h, she remained lethargic. Her abdomen became rigid and distended. Her vitals deteriorated abruptly, as follows: blood pressure, 50/40 mmHg; heart rate, 150 beats/min; respiratory rate, 34 breaths/min; temperature, 38.5°C; and O₂ saturation, 50%. The level of her consciousness deteriorated to a stupor. Emergency abdominal CT scan showed extensive pneumatosis intestinalis with gas bubbles in the portal vein and its branches, mesenteric vein was suggestive of gangrenous bowel perforation due to the progression of acute mesenteric ischaemia (Figure 2). Despite extensive resuscitations, her vital signs remained too unstable to proceed with abdominal emergency surgery. The patient subsequently could not be resuscitated.

Discussion

We present a fatal case of death resulting from AMI with DKA, which was exacerbated by the patient's

avoidance of medical care due to concerns about COVID-19. Since the outbreak of COVID-19, numerous studies have reported that medical care delays might increase morbidity and mortality risk associated with treatable and preventable health conditions.³ The incidence of DKA has increased during the pandemic period. The proportion of DKA in newly diagnosed patients increased and clinical parameters showed overall poor metabolic derangement of diabetes during the pandemic.⁶

DKA is implicated in the pathogenesis of non-occlusive mesenteric ischaemia (NOMI). NOMI can be caused by vascular volume depletion, low cardiac output,

Table 1 The results of laboratory data

Lab values	Result	
Venous blood gas analysis		
pH	7.15	
PaCO ₂	13	mmHg
HCO ₃	4	mmol/L
Base excess	-24	mmol/L
Anion gap	48	mEq/L
Complete blood cell count		
White blood cells	25,500	/μL
Red blood cells	5.11x10 ⁶	/μL
Platelets	437,000	/μL
Blood chemistry		
Glucose	73.9	mmol/L
Ketone	Positive at 1:8	
Osmolarity	441	mOsm/kg
Calculated osmolarity	413.64	mOsm/kg
Sodium	162	mEq/L
Corrected sodium	183.45	mEq/L
Potassium	3.7	mEq/L
Chloride	110	mEq/L
Calcium	10.3	mg/dL
Phosphorus	4.2	mg/dL
Blood urea nitrogen	44.1	mg/dL
Creatinine	1.3	mg/dL
Aspartate aminotransferase	24	IU/L
Alanine aminotransferase	124	IU/L
C-relative protein	0.11	mg/dL
Total cholesterol	318	mg/dL
GAD antibody	Negative	
Insulin antibody	Negative	
C-peptide	0.91	pmol/mL
Urinalysis		
Ketone	3+	
Glucose	3+	

The corrected serum sodium is calculated by increasing the serum sodium concentration by 1 mmol/L for every 62 mg/dL increment in the serum glucose levels.

Calculated Serum osmolarity = (2 x serum [Na]) + [glucose, in mg/dL]/18 + [blood urea nitrogen, in mg/dL]/2.8.

high catecholaminergic expression, and the effects of reactive oxygen species secondary to DKA, which can lead to mesenteric ischaemia and reperfusion injury during fluid treatment.⁶



Figure 1 Abdominal X-ray on hospital admission (mild paralytic ileus).

AMI with a high mortality rate of up to 80%⁴ is important to consider early suspicion because early diagnosis and intervention to adequate reperfusion of mesenteric blood flow can prevent fatal outcomes including deteriorating intestinal necrosis. However, AMI remains a diagnostic challenge for clinicians. It is hard to distinguish in the DKA setting where abdominal pain with vomiting is common. AMI is often known to "pain out of production to examination", and it has no characteristic symptoms at an early stage.⁷

In the case of our patient, due to delayed medical care, it was in a serious condition that initially presented with a severe hyperosmolar state and DKA. Her ingesting large amounts of sugar-rich beverages would have contributed to hyperosmolar metabolic derangement.⁸ On the first examination, her altered consciousness and soft abdomen also made it difficult to suspect the occurrence of AMI. Eventually, our patient was diagnosed with septic shock by bowel necrosis with perforation over 10 hours of intensive therapy. Based on the clinical process of AMI, she was considered to have developed bowel ischaemia on admission.

Clinicians should have high insights into suspicion of AMI in patients with DKA. Early identification of AMI is critical to preventing fatal outcomes.

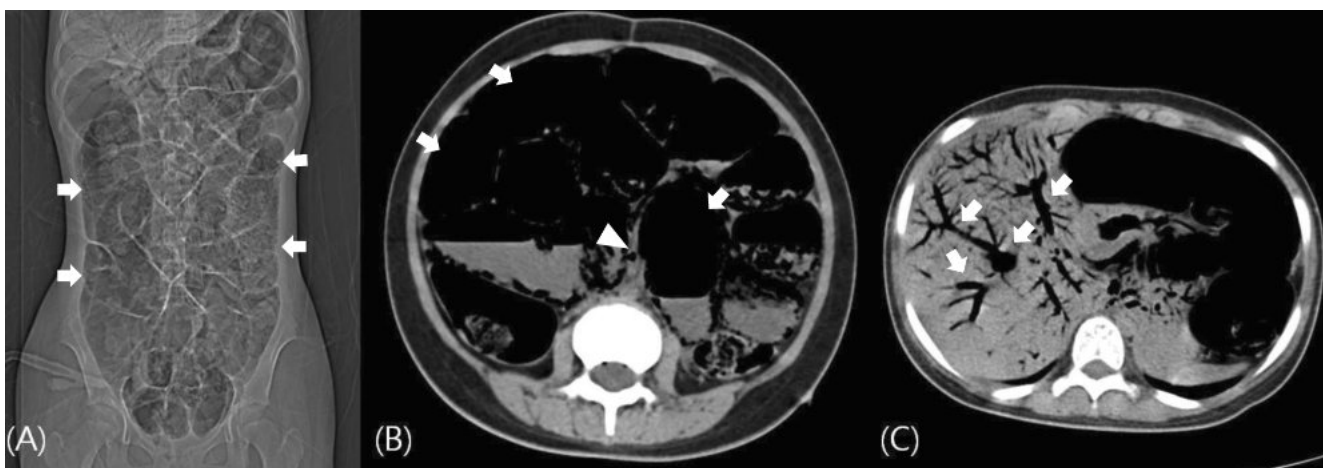


Figure 2 Computed tomography images of the abdomen and pelvis. (A) Aggravated state of gaseous collections in small bowel loops (arrows). (B) Generally distended small bowel and large bowel (arrows) showing air density in the bowel wall (arrowhead). (C) Marked portal venous gas (arrows). Pneumatosis intestinalis with gas bubbles in the portal vein and its branches, mesenteric vein was suggestive of gangrenous bowel perforation.

Conclusion

This report presents a fatal case of a child presenting with AMI complicated by new DKA, which is a rare condition in children. AMI should be initially suspected in patients with severe DKA, even having a soft abdomen in childhood DKA. Increased awareness of pediatric DKA can prevent delays in medical care for early diagnosis of AMI.

This study was approved by the Research Ethics Committee of the Inha University Hospital (approval number: 2023-01-021).

Conflicts of Interest

All authors declare that they have no conflicts of interest.

We are forever grateful for the privilege of being part of our patient's care and extend our deepest condolences to her family and loved ones.

References

1. Boserup B, McKenney M, Elkbuli A. The impact of the COVID-19 pandemic on emergency department visits and patient safety in the United States. *Am J Emerg Med* 2020;38:1732-6.
2. Parmet WE, Sinha MS. COVID-19 - The Law and limits of quarantine. *N Engl J Med* 2020;382:e28.
3. Cherubini V, Gohil A, Addala A, et al. Unintended consequences of coronavirus disease-2019: remember general pediatrics. *J Pediatr* 2020;223:197-8.
4. Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Arch Intern Med* 2004;164:1054-62.
5. Frontino G, Di Tonno R, Castorani V, et al. Non-occlusive mesenteric ischemia in children with diabetic ketoacidosis: case report and review of the literature. *Front Endocrinol* 2022;13:900325.
6. Lee Y, Kim M, Oh K, et al. Comparison of initial presentation of pediatric diabetes before and during the coronavirus disease 2019 pandemic era. *J Korean Med Sci* 2022;37:e176.
7. Trompeter M, Brazda T, Remy CT, Vestring T, Reimer P. Non-occlusive mesenteric ischemia: etiology, diagnosis, and interventional therapy. *Eur Radiol* 2002;12:1179-87.
8. Watanabe S, Kido J, Ogata M, Nakamura K, Mizukami T. Hyperglycemic hyperosmolar state in an adolescent with type 1 diabetes mellitus. *Endocrinol Diabetes Metab Case Rep* 2019;2019:18-0131.