

## CASE REPORT

# Delayed diagnosis in a child with strangulated mesenteric hernia

Kenichi Tetsuhara<sup>1</sup> | Kazunobu Nakabayashi<sup>2</sup> | Mamoru Muraoka<sup>1</sup> | Rie Kikuno<sup>1</sup> |  
Michiko Ueda<sup>2</sup> | Ryo Inoue<sup>1</sup> | Makoto Hayashida<sup>2</sup>

<sup>1</sup>Department of Critical Care Medicine,  
Fukuoka Children's Hospital, Fukuoka, Japan

<sup>2</sup>Department of Pediatric Surgery, Fukuoka  
Children's Hospital, Fukuoka, Japan

**Correspondence**

Kenichi Tetsuhara, Fukuoka Children's  
Hospital, 5-1-1, Kashii-Teraha, Higashi-ku,  
Fukuoka City, Fukuoka 813-0017, Japan.  
Email: [tetsuhara.k@fcho.jp](mailto:tetsuhara.k@fcho.jp)

**Abstract**

**Background:** Strangulated intestinal obstruction is a life-threatening condition that should be considered as a differential diagnosis in children with shock. However, it has pitfalls in diagnosis and can lead to diagnostic errors.

**Case Presentation:** A 3-month-old male patient presented with a pale complexion lasting 2 h and abnormal crying. He was in shock with lactic acidosis, altered mental status, and slight abdominal distension. He required volume resuscitation, vasoactive agents, and transfusion. On Day 2, he had marked abdominal distension and acute kidney injury, which required continuous kidney replacement therapy. Contrast-enhanced computed tomography revealed extensive intestinal ischemia. It took 33.5 h from his arrival to the computed tomography, leading to operative management. The small intestine had entered a mesenteric hiatus, leading to ischemia. He was diagnosed with strangulated mesenteric hernia.

**Conclusion:** In this case, four pitfalls led to delayed diagnosis. Factors for diagnostic errors specific to strangulated intestinal obstruction and intensive care should be noted.

**KEY WORDS**

child, delayed diagnosis, diagnostic errors, mesenteric hernia, strangulated intestinal obstruction

## INTRODUCTION

Strangulated intestinal obstruction is a life-threatening condition that should be considered as a differential diagnosis in children with shock. However, it is difficult to diagnose, and 66% of cases are misdiagnosed in the emergency department.<sup>1</sup> Two factors can lead to diagnostic errors: one is associated with the disease itself, strangulated intestinal obstruction, and the other is related to intensive care. Herein, we report a case of a child with a strangulated mesenteric hernia that led to delayed diagnosis due to pitfalls.

## CASE PRESENTATION

A 3-month-old male patient presented to the emergency department with a pale complexion lasting 2 h and

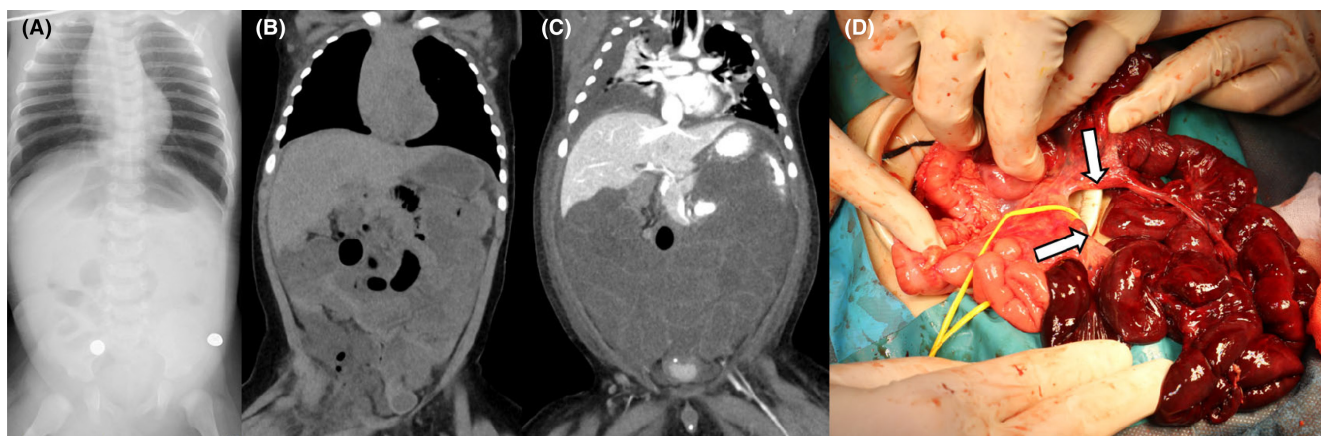
abnormal crying, with no perinatal or medical history. On arrival, his body weight was 6 kg, and his vital signs were as follows: respiratory rate of 27 bpm (irregular) with oxygen saturation of 98% on a facemask with 5 L/min of oxygen, heart rate of 190 bpm, blood pressure of 88/42 mmHg, Glasgow Coma Scale score of E1V3M4, and axillary temperature of 35.0°C. Physical examination revealed cold extremities and weak palpation of the femoral arteries. The abdomen was slightly distended but soft without guarding. Venous blood gas analysis revealed the following: pH, 7.05; partial pressure of carbon dioxide, 66.4 mmHg; bicarbonate, 18.2 mmol/L; and lactate, 85 mg/dL. The laboratory findings are shown in [Table 1](#). Abdominal radiography ([Figure 1A](#)) revealed non-specific findings. Non-contrast abdominal computed tomography (CT) ([Figure 1B](#)) and ultrasonography revealed extensive intestinal wall thickening and a small amount of ascites. He required volume

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**TABLE 1** Laboratory findings of a 3-month-old male patient with strangulated intestinal obstruction.

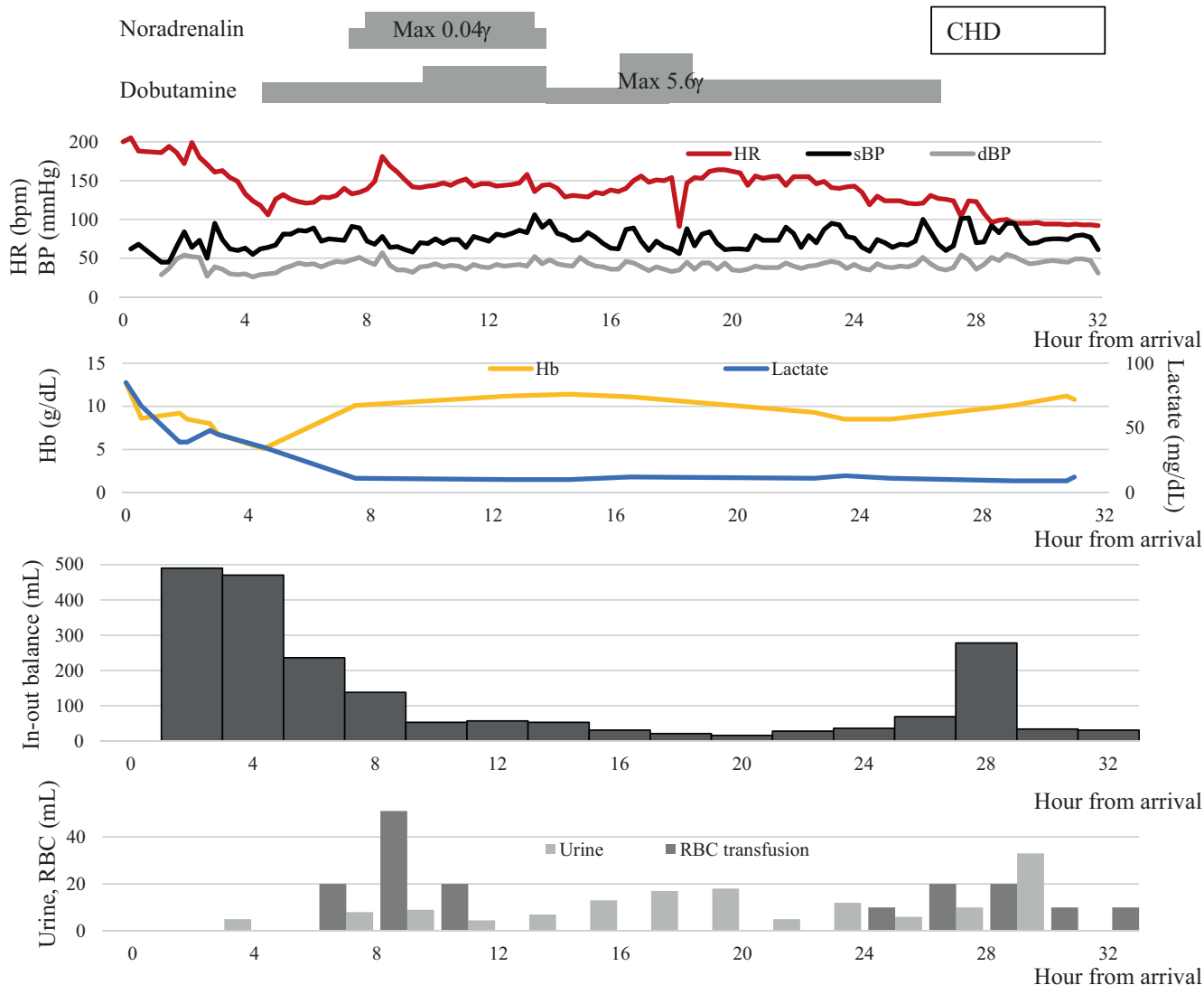
Laboratory test	Value				Reference range
	On arrival	3 h after arrival	5 h after arrival	24 h after arrival	
White blood cell count, / $\mu$ L	23,160	25,560		25,150	4,560–18,900
Neutrophil, %	36.7	52.1		78.5	
Hemoglobin, g/dL	11.7	6.4		9.0	9.5–13.7
Platelet count, / $\mu$ L	687,000	373,000		154,000	250,000–820,000
Prothrombin time-international normalized ratio	1.06	1.60		1.09	
Activated partial thromboplastin time, second	24.2	42.6		27.7	25–35
D-dimer, $\mu$ g/mL	0.9	3.4		2.5	<1.0
Fibrinogen, mg/dL	179	82		226	200–400
Blood urea nitrogen, mg/dL	9		13	28	2.2–14.1
Creatinine, mg/dL	0.33		0.34	0.56	0.14–0.26
Total bilirubin, mg/dL	0.3		0.3	0.4	0.25–0.85
Aspartate aminotransferase, U/L	63		41	138	22.3–66.0
Alanine aminotransferase, U/L	41		21	114	13.0–56.0
Lactate dehydrogenase, U/L	293		351	882	205–418
Creatine kinase, U/L	166		176	562	43–321
Sodium, mEq/L	138		142	145	134.9–142.8
Potassium, mEq/L	5.1		5.8	6.8	4.1–5.6



**FIGURE 1** Images of a 3-month-old male patient with strangulated intestinal obstruction. (A) Abdominal radiography on Day 1 shows non-specific findings. (B) Non-contrast abdominal computed tomography on Day 1 shows extensive intestinal wall thickening and a small amount of ascites. (C) Contrast-enhanced computed tomography on Day 2 shows extensive intestinal ischemia. (D) Operative findings show the ischemic intestine and mesenteric hiatus (arrows).

resuscitation, vasoactive agents, and blood transfusion in the intensive care unit (ICU) (Figure 2). We administered vancomycin and cefotaxime for septic shock, as well as mitochondrial rescue drugs because we suspected metabolic disease based on lactatemia. Hours later, the hemodynamics stabilized, and the lactate level decreased with continuous blood transfusion. He had no bloody stools during the course of the disease. On Day 2, he had marked abdominal distension, decreased urine output, and hyperkalemia. We initiated continuous hemodialysis (CHD) for acute kidney injury. We performed gastrointestinal

fluoroscopy for long tube decompression of a small bowel obstruction. Gastrointestinal fluoroscopy revealed a complete obstruction of the small intestine. Subsequently, contrast-enhanced CT revealed extensive intestinal ischemia (Figure 1C). It took 33.5 h from his arrival to the CT, leading to operative management. Operative findings revealed that the small intestine had entered a mesenteric hiatus (5 cm), 30 cm proximal to the ileum, leading to ischemia (Figure 1D). In total, 202 cm of the small intestine was resected. The necrotic intestine contained bloody contents. He was diagnosed with a strangulated mesenteric



**FIGURE 2** Clinical course of the 3-month-old male patient with strangulated intestinal obstruction. CHD, continuous hemodialysis; dBP, diastolic blood pressure; Hb, hemoglobin; HR, heart rate; K, potassium; RBC, red blood cell; sBP, systolic blood pressure.

hernia. On Day 4, he was weaned off CHD. On Day 13, he was transferred to another hospital, at which time he could consume small amounts of milk orally.

## DISCUSSION

In this case, the diagnosis of strangulated intestinal obstruction was delayed. There are two factors that contribute to delayed diagnosis: the disease itself and the intensive care factor. There are three pitfalls associated with the disease itself. First, we assumed that lactate level improvement reduced the likelihood of strangulated intestinal obstruction. However, lactate is not sensitive enough to exclude mesenteric ischemia even if it is not elevated.<sup>2</sup> Furthermore, the lactate level can decrease with CHD besides physiological stabilization.<sup>3</sup> Second, because the herniated intestine was extensive, the imaging findings were not localized, which reduced the likelihood of our

diagnostic hypothesis for internal hernia. Radiographs are not sensitive enough to exclude small bowel obstruction.<sup>4</sup> Third, the bloody contents of the necrotic intestine were not excreted as bloody stools because the contents were isolated in a closed loop. Active bleeding should be considered if transfusion is needed, especially in poor elevation of hemoglobin level compared to the amount of blood being transfused. The following are some means of reaching a diagnosis more quickly in this case. Factors predicting strangulation in small bowel obstruction include tachycardia, intractable continuous abdominal pain, abdominal distension, white blood cell count  $>13,600/\text{mm}^3$ , ascites on ultrasonography, and wall thickening and/or reduced wall contrast enhancement on CT.<sup>1</sup> A combination of these factors has been reported to further improve diagnostic accuracy.<sup>1</sup> The present case exhibited tachycardia, abdominal distension, white blood cell count  $>13,600/\text{mm}^3$ , ascites on ultrasonography, and wall thickening on non-contrast CT. At that point, strangulation should have been suspected

and a contrast CT should have been performed as soon as the physiologic status stabilized, even though the lactate level was improving.

Diagnostic errors occur in 8%–12% of pediatric ICU patients.<sup>5</sup> Factors that contribute to diagnostic errors in the ICU include high severity and urgency, complexity, fast-changing conditions, inability of patients to cooperate with history taking and physical examination, concurrent treatment of physiologic abnormalities and diagnosis of illness, a high cognitive load on the medical staff with a lot of information and tasks, risk of diagnostic momentum and anchoring bias when a diagnosis has already been made, the deep and broad multidisciplinary communication, and the wide range of diseases.<sup>6</sup> In this case, physiologic stabilization with blood transfusions, vasoactive agent administration, and normalization of test results were given too much priority, and causal investigation was suboptimal. Both stabilization and causal investigation are important and should be performed in parallel.

In conclusion, strangulated intestinal obstruction should be considered in pediatric patients with shock, and factors for diagnostic errors specific to strangulated intestinal obstruction and intensive care should be noted.

#### ACKNOWLEDGMENTS

We thank Dr. Keiichiro Mizuno for the treatment of the patient and critical advice on the manuscript.

#### CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

#### ETHICS STATEMENT

Approval of the research protocol: N/A.

**Informed consent:** Informed consent was obtained from the patient's parents for publication of this case report.

**Registry and the registration no. of the study/trial:** N/A.

**Animal studies:** N/A.

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**How to cite this article:** Tetsuhara K, Nakabayashi K, Muraoka M, Kikuno R, Ueda M, Inoue R, et al. Delayed diagnosis in a child with strangulated mesenteric hernia. *Acute Med Surg.* 2024;11:e977. <https://doi.org/10.1002/ams2.977>