An Autopsy Case of Nonocclusive Mesenteric Ischemia with Bilateral Renal Artery Vasoconstriction

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Corresponding Author: Ibuki Kurihara, e-mail address: kibui.rahiriku@gmail.com

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Patient: Male, 84-year-old

Final Diagnosis: Bilateral renal artery vasoconstriction • nonocclusive mesenteric ischemia

Symptoms: Disturbance of consciousness

Medication: —

Clinical Procedure: —

Specialty: Critical Care Medicine • Nephrology

Objective: Unknown etiology

Background: Nonocclusive mesenteric ischemia (NOMI) is a life-threatening disease. We present the first case to indicate an association between NOMI and renal infarction caused by renal artery vasoconstriction.

Case Report: An 84-year-old Japanese man with no relevant past medical history was evaluated in the Emergency Department for disturbance of consciousness. The patient had a consciousness level of E₁V₁M₄ on the Glasgow Coma Scale, temperature of 29.4°C, blood pressure of 90/40 mmHg, regular pulse rate of 48 beats/min, oxygen saturation of 72% while breathing ambient air, abdominal distention, and abdominal tenderness with peritoneal signs. His hemoglobin levels were 3.6 g/dL, blood urea nitrogen per creatinine 54/1.12 mg/dL, plasma glucose 10 mg/dL, and lactate 12.5 mmol/L. Enhanced computed tomography revealed a dilated and distended large transverse colon, spotted poorly enhanced areas in the bilateral kidneys, and poor contrast enhancement of the bilateral renal arteries. The patient died 48 h after admission due to multiple organ failure. An autopsy revealed dappled hemostasis and ischemia in the transverse colon and bilateral kidneys, with no thrombotic infarction in the superior mesenteric artery and/or bilateral renal arteries. We diagnosed NOMI with acute renal tubular necrosis caused by vasoconstriction of the bilateral renal arteries.

Conclusions: NOMI can occur simultaneously with renal vasoconstriction, suggesting that NOMI and renal artery vasoconstriction may share mechanisms. This case demonstrates that when enhanced computed tomography shows nonenhancing parenchymal regions in both kidneys, clinicians should check for renal artery vasoconstriction and the life-threatening disease of NOMI.

Keywords: Autopsy • Computed Tomography Angiography • Mesenteric Ischemia

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Background

Nonocclusive mesenteric ischemia (NOMI) is a mesenteric circulatory disorder defined as diffuse intestinal ischemia in the presence of a patent arterial trunk [1]. Patients with NOMI account for 20-30% of patients with acute mesenteric ischemia, and NOMI has a mortality rate of 50-80% [2,3]. Elderly patients with NOMI should undergo multidisciplinary disease management, and surgery should always be pursued [4,5]. While NOMI is a life-threatening vascular emergency, early recognition and timely treatment can decrease mortality to 40% [2,6]. However, clinical features of NOMI are vague and overshadowed by precipitating conditions, such as sepsis, hypotension, and cardiovascular surgery, making its diagnosis challenging [7].

Risk factors for NOMI include heart failure, septic shock, dehydration, hemodialysis, cardiac surgery, abdominal surgery, peripheral artery disease, age, diabetes mellitus, and drugs such as vasoconstrictive medications, interferon-alfa-2b, digitalis, cocaine, methamphetamine, and diuretics [8-15]. Hypoperfusion of the peripheral mesenteric artery is the understood mechanism of NOMI [1], but the exact pathophysiological mechanisms are unknown [10,12].

Acute renal infarction is a rare disease which can be caused by embolism, thrombosis, trauma, hypercoagulability, or vasoconstriction of the renal artery after anaerobic exercise [16,17], but can also be idiopathic. Bilateral renal infarctions have been found in patients with atrial fibrillation [18], dissecting aneurysms of the descending aorta with septic emboli from endocarditis [19], vasoconstrictions of the renal artery after anaerobic exercise [17], contrast material [20], hypertrophic cardiomyopathy [21], vasculitis, lupus, sickle cell disease, and fibromuscular dysplasia of the renal arteries [22]. However, no case has been reported so far of NOMI with renal infarction associated with renal artery vasoconstriction.

Case Report

An 84-year-old Japanese man was evaluated in our Emergency Department for coma. One week before admission, he felt fatigued and had loss of appetite. Four days before admission, he managed to go out to see the cherry blossoms with his family. One day before admission, he declined food and was bed-ridden all day. He did not have melena, nausea, vomiting, or abdominal pain. On the day of admission, he was found lying comatose on his bed and was brought to our Emergency Department by ambulance. He had no relevant past medical history and took no medication.

On physical examination, the patient was pale, his consciousness level was E1V1M4 on the Glasgow Coma Scale, his temperature was 29.4°C, his blood pressure was 90/40 mmHg, his pulse rate was regular at 48/min, and his respiratory rate was 18/min. His oxygen saturation breathing ambient air was 72%. Decreased respiratory sounds bilaterally in the lower chest were noted on pulmonary examination, and abdominal distraction and abdominal tenderness with peritoneal signs were observed. The radial and dorsalis pedis arteries were equally palpable bilaterally. The remainder of the physical examination was unremarkable.

Laboratory studies showed a white blood cell count of 14.2×10^3/μL (96% neutrophils), hemoglobin levels of 3.6 g/dL, hematocrit 14.4%, mean corpuscular volume 87.0 fL, platelet count 22.2×10^4/μL, total protein 5.3 g/dL, albumin 2.6 g/dL, total bilirubin 1.6 mg/dL, aspartate aminotransferase 1,450 U/L, alanine aminotransferase 1,450 U/L, alanine aminotransferase 860 U/L, lactate dehydrogenase 3,321 U/L, creatine kinase (CK) 6,638 U/L, CK-MB 279 U/L, blood urea nitrogen 54 mg/dL, creatinine 1.12 mg/dL, sodium 146 mEq/L, potassium 6.2 mEq/L, chloride 113 mEq/L, C-reactive protein 1.84 mg/dL, plasma glucose 10 mg/dL, lactate

Figure 1. Enhanced whole-body computed tomography (CT) of the colon at admission. (A) Coronal view, demonstrating the dilated and distended ascending colon and descending colon. (B) Axial view, indicating the dilated and distended transverse colon.
12.5 mmol/L, pH 7.066, PaO₂ 144.3 mmHg on inhalation of 10 L/min mask oxygen, PaCO₂ 41.4 mmHg, HCO₃⁻ 11.6 mEq/L, cortisol 43.1 μg/dL, thyroid stimulating hormone 0.94 μU/mL, free T4 0.94 ng/dL, prothrombin time/international normalized ratio 1.24, and activated partial thromboplastin time 67.4 s. The acute physiology and chronic health evaluation (APACHE) II score was 26 [19]. Enhanced whole-body computed tomography (CT) indicated the entire colon was dilated and distended (Figure 1A, 1B), the kidneys were normal size and symmetric with multiple bilateral wedge-shaped nonenhancing parenchymal regions (Figure 2A, 2B), and there was no bleeding.

Overall, we found the patient had metabolic acidosis, severe hypoglycemia, severe anemia, coagulopathy, hyperkalemia, hepatic and renal dysfunction, no evidence of hypoadrenalism, and hypothyroidism. Therefore, we diagnosed septic shock and began treatment with fluid replacement, mechanical ventilation, catecholamine, and piperacillin/tazobactam (2.25 g every 6 h). Fifteen hours after admission, the patient’s lactate rose from 12.6 to 23.3 mmol/L. He continued in a state of shock. Piperacillin/tazobactam was switched to meropenem (1 g every 8 h) and vancomycin (1 g every 12 h). Blood, urine, and sputum cultures revealed no significant microorganism. Although we increased his catecholamine dose, urine output was not obtained. We performed continuous hemodiafiltration. His abdomen became more distended and capillary purpura was noted on his skin. Multiple organ failure occurred, and he died 48 h after admission.

At autopsy, we found hemorrhage and necrosis from the ascending colon (Figure 3A), while the small intestine was preserved.
Histological examination showed bleeding, congestion, and infiltration of neutrophils, and empty epithelial cysts were noted in the colon (Figure 3B). We also found ischemia in both kidneys (Figure 4A). Bilateral acute renal tubular necrosis was noted on histological examination, but glomeruli were relatively unaffected, and no invasion by microorganisms was noted (Figure 4B).

No thrombus was detected in the superior mesenteric artery or the renal arteries. No remarkable changes, other than slight congestion, were observed in the spleen. Early gastric cancer at the antrum was an incidental finding, and no remarkable bone-related changes, other than osteoporosis, were noted.

Our final diagnosis was NOMI with acute renal tubular necrosis caused by bilateral renal artery vasoconstriction.

**Discussion**

This report demonstrates that vasoconstriction of both renal arteries can be associated with both NOMI and acute renal tubular necrosis. An important issue arises from the clinical course of our patient. The actual pathophysiology of NOMI remains unknown [3]; however, NOMI may occur simultaneously with renal vasoconstriction, which indicates a shared mechanism between these 2 conditions.

Two possible mechanisms of NOMI in this patient were: (1) direct hypoperfusion of the intestine and kidneys due to septic shock and (2) spasms of the superior mesenteric artery and both renal arteries caused by endothelin secretion and renin-angiotensin axis activation due to septic shock [23-30]. Vasopressin secretion leads to spasms in the mesenteric arteries, especially in the superior mesenteric artery [8,9,24]. Endothelin-I generated from the endothelial cells can trigger endothelin-A receptors located in the bowel mucosa, submucosa, and muscularis and cause the vasoconstriction of the mesenteric vessels [24]. Indeed, elevated endothelin-I can be a risk factor for NOMI after cardiac surgery [25]. In rats, endothelin receptor antagonists have been shown to have a protective effect against ischemia-reperfusion injury of the small bowel [26]. In addition, the
upregulation of endothelin-A and B2 receptors can increase re-
nal artery contractility, which in turn contributes to renal vaso-
spasm and ischemia [27]. Furthermore, the renin–angiotensin
axis, especially angiotensin II, can cause selective splanic vaso-
spasm, reflecting the high sensitivity of the mesenteric vascula-
ture [28]. Increased angiotensin II levels are associated with
mesenteric ischemia in coronary artery bypass grafting [29], and
angiotensin II can induce contraction in the renal artery smooth
muscles [30]. Overall, these pathophysiological mechanisms can
simultaneously cause NOMI and renal vasoconstriction [23-30].

Conclusions

In conclusion, NOMI can occur simultaneously with renal va-
soconstriction. This suggests that NOMI and renal artery vaso-
constriction have shared mechanisms. Our case demonstrates
that when enhanced CT shows nonenhancing parenchymal
regions in both the kidneys, clinicians should check for renal artery vasoconstriction and NOMI.

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Informed Consent

We have obtained the written consent of the patient’s fami-
ly for publication.

Declaration of Figures’ Authenticity

All figures submitted have been created by the authors who
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