Survival of Three Nonocclusive Mesenteric Ischemia Patients following Early Diagnosis by Multidetector Row Computed Tomography and Prostaglandin E1 Treatment

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Abstract

Nonocclusive mesenteric ischemia (NOMI) is an acute mesenteric circulatory disorder which is characterized by spasm and narrowing of the arterial branches. In contrast to occlusive disease, early diagnosis of NOMI is difficult because of its mild symptoms, thus resulting in a high mortality rate. In this study, we report three cases who survived NOMI because of early diagnosis by multidetector row computed tomography and immediate treatment with prostaglandin E1, which is known to improve blood flow by relaxing vascular smooth muscle. We conclude that early diagnosis and treatment of NOMI with prostaglandin E1 considerably improves the prognosis of this disease.

Key words: nonocclusive mesenteric ischemia, NOMI, prostaglandin E1, multidetector row computed tomography, MDCT


Introduction

The first case of nonocclusive mesenteric ischemia (NOMI) with heart failure was first reported by Ende (1) in 1958. Since then, its frequency has increased steadily (2-5), especially among patients on hemodialysis (6-8) and those who have undergone cardiac surgery (9-11). Intestinal vasospasm without vascular occlusion and emboli is believed to be the major etiology of this disease. The symptoms of this disease are vague and lead to difficulty in early diagnosis (2, 3, 5). Delayed diagnosis inevitably results in an irreversible state of disease, and since most of the patients are elderly, the mortality rate is reported nearly 70-90% (3). There is no surgical therapy for NOMI and selective mesenteric angiography followed by papaverine administration has been reported to improve the prognosis (12, 13) however the procedure is invasive for older patients. In the present report, we describe three patients with NOMI, who were diagnosed at an early stage by multidetector row computed tomography (MDCT) and successfully treated thereafter with prostaglandin E1 (PGE1), which is believed to be effective in improving vasospasm and blood flow (14, 15).

Case Reports

Case 1

An 89-year-old woman with a medical history of cerebral infarction was admitted to our hospital after 3 days of abdominal pain, nausea, and vomiting. She was alert upon admission and her blood pressure was 90/50 mmHg. Her pulse was normal at 100 bpm, and respiratory rate was 20 breaths/min. She had a slightly distended abdomen and moderate tenderness was noted. Laboratory data showed slight elevation of hematocrit (Ht) to 48% and blood urea nitrogen (BUN) to 25 mg/dL, which suggested the existence of dehydration. Abdominal X-ray showed niveau formation. Contrast-enhanced 40-row MDCT slices showed an enlarged small intestine that was partly poorly enhanced...
(Fig. 1A and 1B) and the lesions skipped disconnectedly. Multiplanar reconstruction (MPR) images and reconstructed three-dimensional images showed spasm and a narrowing of the mesenteric artery, 6-7 cm peripheral from the root of the superior mesenteric artery (Fig. 1C and 1D). On the basis of these results, the patient was diagnosed with NOMI caused by vomiting-induced dehydration, following which intravenous PGE1 administration was initiated at a dose of 0.01 μg/kg/min and the correction of dehydration by infusion. We gave her drip fusions about 2.5 L/day on the first 2 days. It was necessary to monitor blood pressure and the cardiothoracic rate carefully during the whole PGE1 administration period, because it might cause hypotension and overload infusion has the possibility to show heart failure. Five days after the start of treatment, the vomiting episodes were considerably reduced, and 14 days after admission, MDCT showed improvement in the condition of the intestinal wall and reduction in spasm induced narrowing of the mesenteric artery (Fig. 1E). Intravenous PGE1 administration was discontinued at this point and the symptoms have not recurred thereafter.

Case 2

A 63-year-old man on hemodialysis was admitted to our
Hospital with severe abdominal pain after dialysis. He was alert upon admission and his blood pressure was 100/62 mmHg. His pulse was regular at 120 bpm, and respiratory rate was 30 breaths/min. His tongue was dry and tenderness in the abdomen was noted with absence of rebound tenderness or resistance. Biochemical tests showed creatinine to be 4.8 mg/dL due to chronic renal dysfunction and it was not higher than usual. Contrast-enhanced MDCT slices showed a poorly enhanced edematous intestinal wall (Fig. 2A and 2B) and air density in the portal vein (Fig. 2C) because of the ischemic damage to the intestinal mucosa. Three-dimensional and MPR images showed a severe spastic lesion of the mesenteric artery (Fig. 2D and 2E). On the basis of these results, the patient was diagnosed with NOMI caused by hemodialysis-induced hypotension, following which continuous venous PGE1 administration was initiated at a dose of 0.01 mg/kg/min. Before the administration, we discussed about resection of the ischemic intestine, but finally the patient decided to get medication. On the following day, the abdominal symptom was completely eradicated, and 5 days after the treatment, MDCT showed improved intestinal blood flow, reduction of spasm induced narrowing of the mesenteric artery, and the disappearance of air density in the portal vein (Fig. 2F). PGE1 administration was discontinued at this point and the patient was discharged 7 days after admission to the hospital.

Figure 2. Multidetector row computed tomography (MDCT) findings of case 2. MDCT slices show poorly enhanced edematous intestinal wall. (A) Plain CT. (B) Enhanced image. (C) Air density is noted in the portal vein (white arrow). (D) MPR and (E) Three-dimensional images showing severe spastic lesion of the mesenteric artery (white arrows). (F) MDCT findings 5 days after the initiation of treatment with prostaglandin E1 (PGE1) show improvement in intestinal blood flow and spasm of the mesenteric artery (white arrows).
Case 3

A 76-year-old woman with a medical history of ischemic heart disease and hypertension, for which she had not received regular medication, was admitted to our hospital on sudden onset of abdominal pain. She was alert upon admission and her blood pressure was 120/78 mmHg. Her pulse was regular at 92 bpm, and respiratory rate was 22 breaths/min. Moderate tenderness in the abdomen was noted with absence of rebound tenderness or resistance. Laboratory data were near normal. While contrast-enhanced MDCT slices did not show poor enhancement of the intestinal wall, MPR images showed severe spasticity and a narrow lesion in the mesenteric artery 8-9 cm peripheral from the root of the superior mesenteric artery (Fig. 3A). On the basis of these results, the patient was diagnosed with NOMI caused by vaso-spasm of the mesenteric artery and continuous venous PGE1 administration was initiated at a dose of 0.01 mg/kg/min. On the following day, the symptom had been completely eradicated, and 5 days after the treatment, MDCT showed a reduction in spasm and narrowing of the mesenteric artery (Fig. 3B). PGE1 administration was discontinued at this point and the patient was discharged 9 days after admission to the hospital. She is now being followed up for ischemic heart disease and taking an oral medicine.

Discussion

NOMI is caused by low blood perfusion to the intestine because of a vasospasm, which can be induced by a range of factors such as dehydration, decreased cardiac output, catecholamine treatment, and hypotension (1, 3, 5-11, 16). Reinus et al (2) reported that abdominal pain, distension, and leukocytosis are frequently noted in NOMI patients. Mitsuyoshi et al (4) reported that elevation in glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, and lactate dehydrogenase levels corresponded to the degree of intestinal necrosis in their patients, and the advanced metabolic acidosis as a result of intestinal ischemia indicated progression of intestinal necrosis. All these factors greatly reduced the chance of survival. In the present patients, none of these levels were elevated, indicating that their intestinal ischemia was reversible and survival is possible with early treatment. However, in our aging society, morbidity of this disease is increasing, and the difficulty of early diagnosis because of unclear symptoms and laboratory data is resulting in irreversible ischemic lesion in the intestine, and thus leading to higher mortality (3).

Angiography is thought to be an accurate diagnostic tool for NOMI (7, 17). Boley et al (17) reported that angiography helps in identification of the characteristic features of NOMI such as spasm and narrowing of many branches of the superior mesenteric artery, “string of sausages” sign, spasm of the arcades, and poor enhancement of veins in the muscular layer. Siegelmann et al (18) provided angiographic criteria for the diagnosis of mesenteric vasospasm: narrowing of the origins of multiple branches of SMA, string of sausages sign, spasms of the arcades of mesenteric arteries, and impaired filling of intramural vessels. Clark and Gallant (19), Pérez et al (20) and Franquet et al (21) also described diminished mesenteric blood flow which resulted in absence and variable bowel wall enhancement. Furthermore, selective perfusion through the catheter increased the survival rates (12, 13). However, the instability of general health conditions of the elderly patients makes it risky for them to undergo angiography. Recently, approximately 85% of SMA occlusions and thrombosis can be diagnosed by CT (13), therefore, not all but in most of the cases, we can exclude the occlusive mesenteric disease. The reports on the usefulness of MDCT, which can reconstruct the three-dimensional

Figure 3. Multidetector row computed tomography (MDCT) findings of case 3. (A) MPR images show severe spastic (white arrow) and narrowing lesion (white arrowhead) of the mesenteric artery 8-9 cm peripheral from the root of the superior mesenteric artery. (B) MDCT findings 5 days after the initiation of treatment with prostaglandin E1 (PGE1) show improvement of spasm (white arrow) and narrowing of the mesenteric artery (white arrowhead).
images of the mesenteric artery, show that this imaging
technique can depict the condition of the arteries in suf-
cient detail to enable early diagnosis of NOMI, thus avoid-
ing the invasiveness of angiography (4, 22). An additional
advantage of MDCT imaging was that we were able to ob-
tain the follow-up images after the initiation of PGE1 treat-
ment, showing the improved blood flow of the intestine.
Therefore, based on these results, we report the safety and
diagnostic accuracy of MDCT imaging that allows early
detection of NOMI.

Reviewing these reports and our cases, we provide criteria
for the CT diagnosis of NOMI as following for early diag-
nosis and improvement of survival in the patients. 1) No oc-
cclusion nor thrombus in the main arteries. 2) Segmentally
variable enhancement of the intestinal walls, due to dimin-
ished blood, despite retention of the principal arterial flow
to the peripheral intestinal marginal arteries. 3) Spasm-
induced narrowing of the mesenteric arteries is shown 5-8
cm peripheral from the root of the SMA. And this change is
the same finding as that shown in angiography as the “string
of sausage” sign. 4) These changes are reversible a few days
following the PGE1 treatment and with improvement of the
abdominal symptoms. The diagnostic algorithm looking for
NOMI rules out occlusive disease by MDCT. Subsequently,
when one of the signs described are present, NOMI is as-
sumed and PGE1 treatment is initiated. Patients have to be
monitored closely and surgical therapy has to be considered
when symptoms do not improve. In this study, we report
three patients, who were successfully diagnosed upon admis-
sion with early-stage NOMI on the basis of the information
derived from the MDCT imaging.

Treatment options for NOMI vary according to the severe-
ity of the patient’s condition; however, in all cases the fo-
cus is on controlling the etiological factors of the disease
such as heart disease, dehydration, and catecholamine treat-
ment (1, 3, 5-11, 16). Administration of papaverine hydro-
chloride through angiographic catheter to the mesenteric ar-
tery is thought to relieve vasoconstriction (7, 12, 13, 17),
and the data on intravenous PGE1 treatment have shown it
to be effective in improving the vasospastic lesion and intes-
tinal blood supply by relaxing vascular smooth muscle (14,
15). Accordingly, this mechanism is often used to improve
the blood supply to vascular obstructive lesions in the ex-
tremities and to improve the contrast efficiency of abdomi-
nal angiography of the portal vein by increasing the intesti-
nal blood flow. Mitsuyoshi et al (4) reported that 8 of their
9 NOMI patients, diagnosed during the early stages of dis-
ease progression, survived when treatment with continuous
intravenous high-dose PGE1 (0.01-0.03 mg/kg/min) was ini-
tiated at that time. Our three NOMI patients, diagnosed
early by MDCT and followed by treatment with PGE1, have
also survived. Therefore, these three cases substantiate the
efficiency of PGE1 for NOMI treatment. Administration of
PGE1 through the peripheral vein instead of a catheter in
the mesenteric artery might be a safer method of administra-
tion, however, PGE1 inhibits platelet aggregation and care
must be taken with its use in elderly patients who are at risk
for hemorrhage. However further study in this area of gas-
troenterology is needed, we conclude that early diagnosis
of NOMI by MDCT imaging followed by treatment with PGE1
can increase the survival rates of NOMI patients.

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