Two Cases of Intestinal Ischemia Associated with Hepatic Portal Venous Gas

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Abstract
Hepatic portal venous gas is a rare but important radiographic finding that is frequently associated with intestinal ischemia and high mortality. Here we report two cases. Case 1 was an 84-year-old man with respiratory failure and hypotension. Enhanced abdominal computed tomography (CT) revealed intraperitoneal effusion and gas in the branches of the portal vein in the peripheries of the liver. An emergent laparotomy was performed. A long section of the small intestine was necrotic, and 270 cm was resected. Pathological findings revealed ischemic enteritis. The patient died the day following surgery. Case 2 was a 78-year-old man who had hematemesis and melena. Enhanced abdominal CT revealed intraperitoneal effusion, intramural bowel gas, and intrahepatic portal venous gas. A long section of the small intestine and large intestine was discontinuously necrotic and about 300cm was resected. The patient died from acute myocardial infarction on the 12th day after surgery. Hepatic portal venous gas, particularly when associated with pneumatosis intestinalis, is an important finding suggestive of bowel ischemia. Clinicians must carefully distinguish ischemic from non-ischemic cases.

Key words: hepatic portal venous gas, intestinal ischemia, pneumatosis intestinalis

Introduction
Hepatic portal venous gas is a rare but important radiographic finding frequently associated with intestinal ischemia and high mortality. We encountered two cases of intestinal ischemia associated with hepatic portal venous gas. One case also demonstrated pneumatosis intestinalis. Here we report these two cases.

Cases
Case 1
An 84-year-old man was transferred from a nursing home to our emergency and critical care center because of respiratory failure and hypotension. He had been diagnosed with von Recklinghausen disease at a young age. On arrival, he was very unwell. Systolic blood pressure was 52 mmHg, heart rate was 92 /min and irregular, and respiratory rate was 34 /min. The conjunctivae were pale, and abdominal examination revealed generalized tenderness and muscle guarding.

Laboratory data included white blood cell count 8,500 /μl, platelet count 10.2×10⁴ /μl, C-reactive protein 3.23 g/dl, creatinine kinase 115 IU/l, aspartate aminotransferase (AST) 31 IU/l, alanine aminotransferase (ALT) 20 IU/l, and lactate dehydrogenase (LDH) 279 IU/l. Arterial blood gas analysis showed a base excess of −24.4 mmol/l and severe metabolic acidosis. Atrial fibrillation was evident on the electrocardiogram. Enhanced abdominal computed tomography (CT) revealed intraperitoneal effusion and gas in the branches of the portal vein in the peripheries of the liver (Fig. 1).

An emergent laparotomy was performed. A long section of the small intestine was necrotic (Fig. 2): 270 cm needed to be resected, and a jejunostomy...
Intestinal ischemia associated with hepatic portal venous gas

Fig. 1  Enhanced abdominal CT findings in case 1 on arrival. Intraperitoneal effusion and gas in the branches of the portal vein in the peripheries of the liver were shown.

was constructed. Pathological examination of the resected specimen revealed ischemic enteritis, but the mesenteric artery showed no remarkable sclerosis. After the operation, the patient was admitted to our intensive care unit where his shock and disseminated intravascular coagulopathy worsened. He died the next day.

Case 2
A 78-year-old man was transferred to our emergency and critical care center from another hospital because of hematemesis and melena. He had undergone laparotomy two months previously because of strangulation ileus. On arrival, he was very unwell. Blood pressure was 80/40 mmHg, and heart rate was 100/min and irregular. The conjunctivae were pale, and the abdomen demonstrated generalized tenderness with muscle guarding.

Laboratory data revealed a slightly decreased white blood cell count (3,700 / μl) and elevated C-reactive protein level (20.91 g/dl), both indicating severe inflammation. Creatinine kinase was 102 IU/l, AST 21 IU/l, ALT 19 IU/l, and LDH 183 IU/l. Arterial blood gas analysis showed a base excess of –16.2 mmol/l and severe metabolic acidosis. Atrial fibrillation was shown on the electrocardiogram. Blood culture revealed methicillin-resistant Staphylococcus aureus. Intraperitoneal effusion, intrahepatic portal venous gas, and intramural bowel gas were evident on enhanced abdominal CT (Fig. 3).

An emergent laparotomy was performed. A long section of the small intestine and large intestine was discontinuously necrotic (Fig. 4), and we diagnosed non-occlusive mesenteric ischemia. On palpitation, we found that part of the wall of the small intestine had pneumatosis intestinalis, as revealed by CT. About 300 cm of the small and large intestine was resected, and an ileostomy was constructed. Pathological examination revealed ischemic enteritis and colitis, but the mesenteric artery had no remarkable sclerosis.

After the operation, the patient was cared for in our intensive care unit where he slowly recovered. However, cerebral infarction occurred on postoperative day 10 and myocardial infarction on day 11. He died the following day.

Discussion
Hepatic portal venous gas was first described in 1955 in infants with necrotizing enterocolitis. In 1960, the first adult case was reported; this was associated with small bowel infarction. There have since been many reports of hepatic portal venous gas. In 1978, Liebman et al. reviewed 64 cases of hepatic portal venous gas and reported a mortality rate of 75%. In 2001, Kinoshita et al. reviewed 182 cases of hepatic portal venous gas in adults. In that series, the mean age was 55 years, 62% of patients were male, and overall mortality was 39%. However, mortality rate depended on the underlying disease, and that of hepatic portal venous gas associated with bowel necrosis was still 76%. Many other
Fig. 3  Enhanced abdominal CT findings in case 2 on arrival. Intraperitoneal effusion, intrahepatic portal venous gas (left), and intramural bowel gas (right) were evident.

Fig. 4  Operative findings in case 2. A long section of the small intestine and large intestine was discontinuously necrotic.

reports\(^6\) have documented similarly high mortality rates from bowel necrosis associated with hepatic portal vein gas. In addition to bowel necrosis, many conditions related to hepatic portal venous gas, such as intraperitoneal abscess, distension of parts of the digestive tract, ulcerative colitis, and gastric ulcer, have been reported\(^5\).

Hepatic portal venous gas may be demonstrated on plain abdominal X-rays, although CT is a more sensitive modality\(^6\). Recent increases in the use of abdominal CT have led to increased detection of hepatic portal venous gas associated with various non-ischemic conditions. The radiographic criterion for hepatic portal venous gas is a branching radiolucency extending to within 2 cm of the liver capsule\(^6\). On the other hand, air in the biliary tree (pneumobilia) is located centrally in the liver. Liebman et al.\(^5\) proposed three causes of hepatic portal venous gas: mucosal damage, bowel distention, and sepsis caused by gas-producing bacteria. It is well known that one or more of these factors may be present and contribute to hepatic portal venous gas.

Hepatic portal venous gas may also occur in non-ischemic conditions. The majorities of non-ischemic cases do not require surgical intervention and have a favorable outcome. In contrast, ischemic cases require emergent operation and have a high mortality rate\(^6\). Therefore, when portal venous gas is detected, we must distinguish between ischemic and non-ischemic etiology. A careful abdominal examination to detect findings indicating peritonitis, vital signs indicating shock, and CT findings such as poor enhancement of the intestine, free air, or peritoneal fluid correction are helpful. In this way, unneces-
sary laparotomy can be avoided.

Pneumatosis intestinalis is frequently associated with hepatic portal venous gas\(^{13,14}\), and the combination of these two findings is often associated with mesenteric ischemia. Wayne et al.\(^{15}\) reported that 12 of 13 cases of intestinal ischemia with hepatic portal venous gas were associated with pneumatosis intestinalis, and Shinder et al.\(^{16}\) reported such an association in six of six cases. In some cases, CT has detected gas in the mesenteric vein with hepatic portal venous gas\(^{17}\). Intestinal ischemia results in damage to the intestinal barrier that, in association with over-distension of the bowel and proliferation of gas-forming bacteria, leads to gas moving from the intestinal wall into the portal vein system.

References