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## Survival Following Gas in the Portal Venous System: A Report of Two Cases

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**T**HE radiological demonstration of gas in the portal venous system is of extremely grave prognostic significance.

A review of 14 cases collected from the British and American literature was published in 1964.<sup>1</sup> All but one of these patients died within 24 hours. The exception survived for seven days. In the past two years there have been only two reports of survival of patients who had gas in their portal venous systems.<sup>2, 3</sup> One of these was an adult with ulcerative colitis who developed pneumoperitoneum and portal venous gas following a double contrast enema.<sup>2</sup> The other was an infant with pneumonia and osteomyelitis who developed severe enterocolitis with septicemia and gas in the portal venous system.<sup>3</sup> Pathogenic *E. coli* were cultured from stool specimens from this infant.

This is a report of two additional patients, encountered in the past year, who had gas in their portal venous systems and survived.

### CASE 1

A 60-year-old white woman with a past history of a severe megaloblastic anemia of obscure etiology

was admitted to hospital with nausea, lower abdominal cramps and bloody diarrhea of one day's duration. She had been given a transfusion before admission.

On admission she had watery, yellow diarrhea, but normal bowel sounds. Physical examination revealed slight periumbilical tenderness, moderate hepatomegaly, a blood pressure of 122/70 mm. Hg and a pulse rate of 136 per minute. There was no evidence of splenomegaly or lymphadenopathy. The hemoglobin was 8.8 g. per 100 ml. and the white blood cell count was 4500 per ml., with 68% neutrophils.

The next morning the abdominal tenderness was diffuse and the bowel sounds were absent. Plain films of the abdomen showed marked gaseous distension of the small bowel, with prominent mucosal folds, intramural air and a branching pattern of gas in the liver (Figs. 1 and 2).

Because of her grave clinical condition and the presence of gas in her portal venous system, it was decided to institute immediate, energetic, combined medical and surgical treatment.

Samples were taken for blood and urine cultures, and massive doses of antibiotics were started: penicillin 40,000,000 units, tetracycline intravenously, and hydrocortisone 300 mg. intravenously were given.

A laparotomy was performed four hours after gas in the portal venous system had been demonstrated.

At operation massive gangrene of the small bowel was found to extend from the ligament of Treitz

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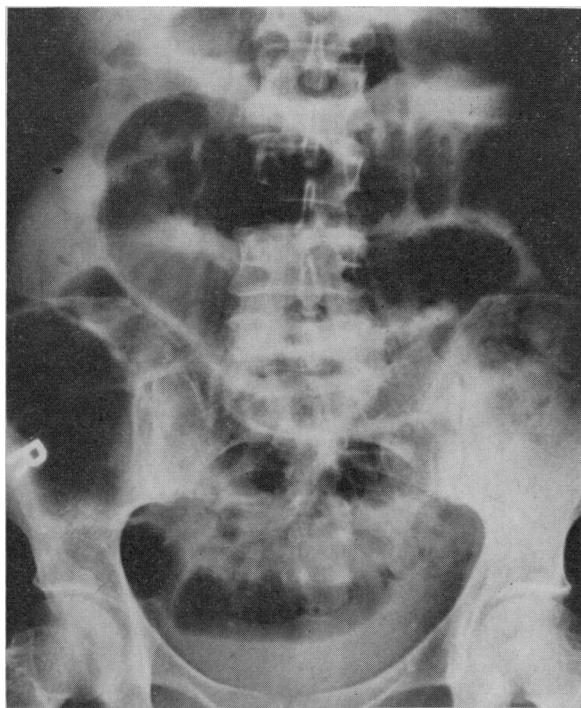


Fig. 1.—Case 1. Plain film of the abdomen showing gaseous distension of the small bowel and air in the intestinal wall.



Fig. 2.—Case 1. Close-up view of the right upper quadrant showing gas in the portal venous system.

to five feet proximal to the ileocecal valve. The superior mesenteric artery was thrombosed and pulseless at its root. The necrotic bowel was resected and intestinal continuity was re-established. During the operation the patient was maintained on blood transfusions, vasopressors and steroids, and was given other supportive measures, but for a great part of the procedure her pulse and blood pressure were imperceptible. However, after removal of the necrotic bowel, she rallied quickly and her condition stabilized.

Her postoperative course was surprisingly smooth. Massive antibiotic therapy was continued for one week. The results of the preoperative blood culture were negative.

Eleven days after the operation the radiological examination of the gastrointestinal tract showed no abnormality of the colon or of the remaining small bowel. Tests of bowel absorption, including a Schilling test and an examination of the stool for fat absorption, were carried out before she was discharged, and were within normal limits.

#### CASE 2

A 42-year-old white woman with severe diabetes of 18 years' duration was admitted after three days of extensive upper gastrointestinal bleeding. She had been transfused in a local hospital before admission to the University of Alberta Hospital. At this time she was very ill, with diabetic ketosis, a blood sugar of 648 mg. per 100 ml., hypotension (blood pressure 60/0 mm. Hg) and profound weakness.

There was a clinical history of peptic ulcer, although previous radiological investigation of the upper gastrointestinal tract had been negative. Following admission, an upper gastrointestinal series showed a large penetrating ulcer of the lesser curvature of the stomach, and faint, bifurcating, linear, reticular radiolucencies in the portal venous system, more evident in the left lobe of the liver (Fig. 3).

Blood was taken for culture; massive doses of antibiotics were started both intravenously and intramuscularly; and four units of blood were given.

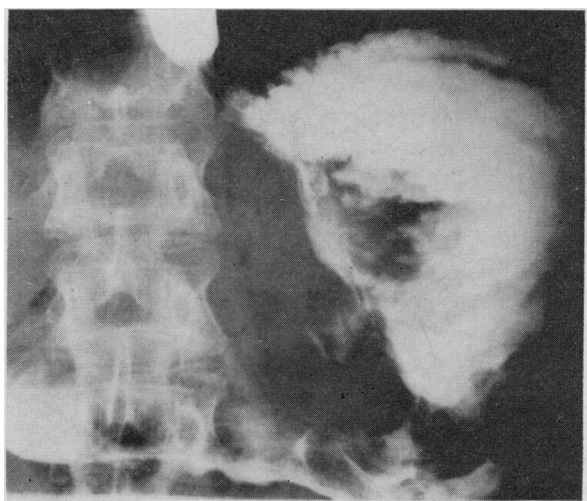


Fig. 3.—Case 2. Upper gastrointestinal series showing a large ulcer crater of the lesser curvature, and bifurcating linear reticular gas pattern in the portal venous system.

Insulin was also given both intravenously and intramuscularly.

Because of continued massive bleeding and the grave significance of gas in the portal venous system, a laparotomy was performed.

At operation a large indurated ulcer with a deep crater was found on the lesser curvature of the stomach. A subtotal gastrectomy was done. The patient had a relatively smooth postoperative course. The preoperative blood culture was negative. The antibiotics were discontinued five days after the operation. The patient was discharged 13 days after admission.

One other case of portal venous gas resulting from a gastric ulcer perforating into the lesser omental sac has been described by Rigler and Pogue.<sup>4</sup>

#### DISCUSSION

Thirty-seven patients with gas in their portal venous systems have been reported by various authors.<sup>1-14</sup>

Goldstein *et al.*<sup>3</sup> found that the most common cause in adults was mesenteric vascular occlusion with bowel necrosis. It also occurred as a result of acute hemorrhagic pancreatitis with marked intestinal dilatation, closed loop obstruction with intestinal gangrene, necrotizing enterocolitis, and bowel necrosis with severe atherosclerosis of mesenteric vessels without occlusion. One patient was a 35-year-old diabetic in acidosis and shock, who had marked bowel distension and congestion without vascular obstruction or necrosis of the bowel.

In infants and children, gas in the portal venous system has been noted in necrotizing enterocolitis in premature infants, intestinal obstruction with peritonitis in imperforate anus, esophageal atresia, duodenal atresia, postoperative peritonitis, idiopathic diarrhea, mesenteric vein thrombosis with gangrene of bowel and severe dehydration, and erythroblastosis fetalis.

The origin of the gas in the portal vein is still obscure. Wiot and Felson<sup>5</sup> believe that in most patients the intravascular gas in the liver results from migration of gas-forming enteric organisms into the portal venous system through damaged intestinal wall. Other workers<sup>6, 7</sup> believe that the gas from the distended bowel, under increased pressure, enters the mesenteric vessels through necrotic areas in the intestinal wall. In both of these theories intestinal distension, congestion and necrosis would appear to play an important role.

In a recent study of six patients from three hospitals, Rigler and Pogue<sup>4</sup> were unable to demonstrate the presence of gas-forming organisms. Wiot and Felson<sup>5</sup> have stressed the impor-

tance of isolating these organisms in culture. Our findings were similar to those of Rigler and Pogue in that we were unable to demonstrate the presence of gas-forming organisms in our cases.

Gas in the portal venous system can be differentiated from gas in the biliary radicles by two radiological signs.<sup>7</sup> Portal venous gas appears as faint, bifurcating, linear, reticular radiolucencies in the right upper quadrant extending to the periphery of the hepatic shadow; this appearance is probably due to centrifugal blood flow. Biliary tree gas is located in large channels and appears caudally and centrally, often with gas present in the common bile duct and the gall-bladder if the latter structure is not removed; this appearance is believed to be limited by centripetal bile flow.

#### CONCLUSION

The presence of gas in the portal venous system is an important diagnostic feature of an extremely grave clinical condition.

Its importance as a diagnostic aid is enhanced because it is easily demonstrated on the plain films of the abdomen, without administration of any contrast medium.

The fact that two cases were encountered in our hospital in a period of one year implies that the condition is more common than would appear from the literature. In acute abdominal conditions, the severity of the underlying cause may be suspected more readily if a careful examination is made of plain films of the abdomen for the characteristic, faint, bifurcating radiolucencies in the right upper quadrant. Prompt and vigorous combined medical and surgical treatment following an early diagnosis may reduce considerably the high mortality rate associated with the presence of gas in the portal venous system.

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