CASE REPORT

Case of pneumatosis intestinalis and hepatic portal venous gas following a laparoscopic right hemicolectomy

Edit Elisa Castren,¹ Abdul R Hakeem,¹ Nabil S Mahmood,² Kamal Aryal¹

¹Department of General and Colorectal Surgery, James Paget University Hospitals NHS Foundation Trust, Great Yarmouth, Norfolk, UK

²Department of Radiology, James Paget University Hospital, Gorleston, UK

Correspondence to
Dr Edit Elisa Castren,
edit.castren@gmail.com

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SUMMARY

Hepatic portal venous gas (HPVG) in most cases signifies either mechanical migration of air into the portal system due to bowel ischaemia (pneumatosis intestinalis) or portal sepsis due to gas-forming organisms. Successful management of portal sepsis involves early identification of the condition, intensive resuscitation, broad-spectrum antibiotics and a laparotomy for possible bowel ischaemia. In this report, we discuss the case of a patient with pneumatosis intestinalis and HPVG after an elective laparoscopic right hemicolectomy. After an initial slow recovery, on postoperative day seven, the patient had profuse diarrhoea and confusion, and was hyponatraemic. A CT scan revealed pneumatosis intestinalis and HPVG. A laparotomy showed no obvious cause for HPVG and there was no ischaemic bowel. She was managed with intensive care, hyperbaric oxygen therapy, broad-spectrum antibiotics and total-parenteral nutrition. She has made a good recovery. This case highlights the presenting features, differential diagnoses, and management of pneumatosis intestinalis and HPVG.

BACKGROUND

Pneumatosis intestinalis is defined as 'the presence of gas within the serosal or mucosal layer of the bowel wall'.¹ The most common cause is bowel ischaemia. Pneumatosis intestinalis is associated with hepatic portal venous gas (HPVG) in 60–80% of cases.¹ The presence of HPVG is alarming for intestinal ischaemia as this is its most common cause.² When pneumatosis intestinalis is caused by intestinal ischaemia, it carries a mortality rate of 90%.^{1 3} However, pneumatosis intestinalis can also be a benign condition associated with immunosuppressed states such as AIDS, malignancy or chemotherapy.¹

Although intestinal ischaemia is the most common cause of HPVG, there are a number of other causes, including severe ulcerative colitis, intra-abdominal abscess with gas-forming organisms, small bowel obstruction with ischaemia and gastric ulcer perforation.³

The main differential diagnosis for HPVG is pneumobilia. The two states are differentiated radiologically. Owing to the blood flow of the portal venous tract, HPVG tends to appear radiolucent in the peripheral aspects of the liver and extends to within 2 cm of the liver capsule. In contrast, pneumobilia is concentrated more centrally around the hilum, due to the direction of biliary flow.⁴

In this report, we discuss a case of combined pneumatosis intestinalis and HPVG after laparoscopic bowel surgery.

CASE PRESENTATION

A 74-year-old independent woman was diagnosed with an ascending colon adenocarcinoma identified at colonoscopy and endoscopic mucosal resection (EMR), and confirmed on histological analysis of the resected polyp with involved margins. She was admitted for an elective laparoscopic right hemicolectomy of the radiologically staged T2N1M0 tumour. Her medical history included a stage 3B T2bN1 cervical cancer, treated with radical chemoradiotherapy and brachytherapy, gastro-oesophageal reflux disease and oesophageal achalasia, which was recently managed with gastroscopy and botulinum toxin injections. A laparoscopic right hemicolectomy was performed in a standard manner by four-port technique (10 mm umbilical and left iliac fossa ports; 5 mm right iliac fossa and left upper quadrant ports) and intestinal continuity restored by an extracorporeal side-to-side ileocolic stapled anastomosis using GIA 80 and TA 90 (Covidien) staplers.

On days 1–3 postoperatively, the patient felt well, was passing flatus, and managing to eat and drink. On day 4 postoperatively, she had one episode of bilious vomiting, but felt well in herself and examination of her abdomen was soft, and non-tender. On days 5 and 6 postoperatively, the patient complained of abdominal discomfort, nausea, occasional vomiting and loose stools. Her inflammatory markers were falling and the remainder of her blood tests were normal except a serum sodium of 122 mmol/L.

On day 7 postoperatively, she had severe diarrhoea and fatigue, and became confused and disorientated. On examination, she was afebrile, had sinus tachycardia at 100 bpm and her blood pressure was 160/110 mm Hg. Her abdomen was soft and non-tender. There was minimal discharge from one of the operative wounds, which was managed by removing a small number of clips. However, her urine output had declined in the preceding 24 h.

INVESTIGATIONS

Haematological and biochemical markers were repeated and showed a white cell count of $11.7 \times 10^9/L$, sodium 119 mmol/L, potassium 3.5 mmol/L, urea 12.6 mmol/L, creatinine 70 $\mu\text{mol/L}$, bilirubin 28 $\mu\text{mol/L}$, alkaline phosphatase 87 IU/L,

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alanine transaminase 29 IU/L, albumin 29 g/L and C reactive protein of 171 mg/L. The inflammatory markers had worsened from the previously improving results, and the sodium had reduced significantly. An urgent arterial blood gas test revealed a lactate of 2.4 and base excess of -2.1 . The patient was resuscitated with intravenous fluids and broad-spectrum antibiotics were initiated. Urgent CT imaging of the abdomen and pelvis was undertaken to assess for an anastomotic leak or intra-abdominal collection.

The CT scan showed air within the superior mesenteric and intra-hepatic portal vein branches (figure 1A, C), and also demonstrated gross pneumatosis intestinalis of the stomach, small and large bowel extending to the oesophagogastric junction (figure 1A–D). There was no evidence of mediastinal or intraperitoneal free gas.

DIFFERENTIAL DIAGNOSIS

The primary concern considering the CT scan findings was bowel ischaemia. However, the differential diagnosis included anastomotic leak, hollow-viscus perforation and an intra-abdominal collection with sepsis.

TREATMENT

The clinical picture and the CT scan findings signified that urgent laparotomy was indicated following resuscitation. The recent midline incision was extended to perform the relook laparotomy. The ileocolic anastomosis was intact, and there was no evidence of any intraperitoneal contamination or collections. The small bowel appeared grossly dilated, with no evidence of ischaemia or perforation. However, there was pneumatosis (palpable as crepitus) along the proximal small bowel, extending to the stomach. The pneumatosis within the small bowel was 20–30 cm proximal to the ileocolic anastomosis. In view of the pneumatosis, the decision was made to create a loop ileostomy in the right iliac fossa, proximal to the ileocolic anastomosis, to minimise the risk of leakage at the anastomosis, facilitate decompression of the more proximal small bowel, and also to allow direct observation of the small bowel for potential

ischaemia. Overall, the laparotomy excluded bowel ischaemia as the cause of the pneumatosis intestinalis and HPVG, therefore making translocation from gas-forming enteritis and portal sepsis the most likely cause, as discussed below.

The patient remained intubated in the intensive care unit postoperatively and was treated with a single session of hyperbaric oxygen therapy. The high-pressure oxygen therapy was hypothesised to eradicate the gas within the vasculature to reduce the risk of air emboli. It may also facilitate the control of anaerobic portal sepsis and provide for the increased requirements for high-pressure oxygen due to sepsis. The patient received inotropic support, broad-spectrum antibiotics and total parenteral nutrition (TPN). Her stoma started working on the first day postoperatively. A repeat CT scan of the abdomen and pelvis on day 1 postoperatively showed considerable resolution of air within the portal venous system and the pneumatosis intestinalis (figure 2); therefore, further hyperbaric oxygen therapy was not needed. She also had a CT scan of her head to exclude migration of air intracranially, and because of her pre-operative obtunded state and confusion; this scan was normal.

The patient was transferred to a surgical ward on the fifth day after the relook laparotomy. She was subsequently treated with 10 days of intravenous tazobactam-piperacillin and enteral nutrition was slowly increased with weaning of TPN. She continued to be hyponatraemic (range 119–130), which was felt to be most likely due to her stoma output, which was in the range of 650–1000 mL. The hyponatraemia was managed with intravenous fluids and oral salt intake, and reducing stoma output was achieved with a combination of dioralyte solution, oral fluid restriction, loperamide and codeine phosphate. The patient was subsequently discharged a month following her laparoscopic right hemicolectomy.

OUTCOME AND FOLLOW-UP

The patient was followed up in clinic 2 and 6 weeks after discharge and remained well. The histological staging of the cancer was pT0, N0, V0, R0, the previous pT1 adenocarcinoma having

Figure 1 Arrow showing (A) air in the portal venous radicles within the liver, (B) intramural air in the stomach, (C) air in the rectum and (D) air in the small bowel (short arrow) and one of the mesenteric venous channel (long arrow).

Figure 2 Resolution of pneumatosis intestinalis and hepatic portal venous gas 24 h after relook laparotomy and hyperbaric oxygen therapy.

been removed by EMR. Thus, the patient did not need any adjuvant chemotherapy.

DISCUSSION

A small number of cases of pneumatosis intestinalis postoperatively from laparoscopic bowel surgery are described. Shah *et al*⁵ highlighted two cases of symptomatic pneumatosis intestinalis after laparoscopic total colectomy that were managed conservatively. Both patients underwent emergency laparoscopic total colectomy for inflammatory bowel disease. Both patients had CT confirmation of pneumatosis intestinalis, and one patient had HPVG. These patients were clinically stable and thus managed conservatively with TPN and empirical antibiotic therapy, and recovered, suggesting that CT diagnosis of pneumatosis intestinalis and HPVG does not necessarily signify the need for a relook laparotomy.⁵

HPVG is often associated with pneumatosis intestinalis. However, a CT scan cannot determine whether the pneumatosis is associated with bowel ischaemia.³ As bowel ischaemia is the most common cause for HPVG (60–80%) and when associated, mortality is approximately 90%, the importance of urgent surgery cannot be underestimated.^{1 3}

A mechanical theory due to ischaemic bowel damage and a bacterial theory due to gas-forming organisms have been explained to be the two causes of HPVG.^{6 7} In this case, it was felt that gas-forming enteritis led to portal sepsis causing air within the hepatic portal venous system and the pneumatosis intestinalis.

The development of hyponatraemia postoperatively may have been an early sign of deterioration. Necrotising enterocolitis (NEC) in neonates is also a cause of pneumatosis intestinalis and HPVG. Hyponatraemia in infants with NEC is a recognised and worrisome sign indicating capillary leak and third-space loss of fluid into the peritoneal space and bowel lumen.⁸

Tahiri and colleagues report the use of hyperbaric oxygen treatment in pneumatosis intestinalis. They describe that, in the presence of pneumatosis intestinalis secondary to anaerobic bacteria, inhalation of oxygen or hyperbaric oxygen therapy can reduce the partial pressure of non-oxygen gases within the venous system, therefore promoting diffusion out of the bowel wall.⁹ Azzaroli *et al*¹⁰ also support the use of hyperbaric oxygen in pneumatosis intestinalis; however, they

emphasise the importance of monitoring for signs of oxygen toxicity.

We suggest that emergency laparotomy combined with hyperbaric oxygen therapy was an appropriate treatment for this patient, as it led to rapid improvement in her condition, and this was accompanied by resolution of HPVG and pneumatosis intestinalis. However, it is possible that the patient would have recovered without these interventions. However, as on the seventh day postoperatively she was rapidly deteriorating clinically, conservative measures were not an option and the benefits of surgery outweighed the risks of conservative management. This approach is supported by Greenstein *et al*,¹¹ who state that the association of HPVG with pneumatosis intestinalis with suspected bowel ischaemia is an indication for surgery. The stoma was formed to allow monitoring of the bowel.

Therefore, we conclude that this is a rare case of pneumatosis intestinalis and HPVG after a laparoscopic right hemicolectomy. The cause for this is most likely secondary to gas-forming enteritis with translocation of bacteria to the portal venous system. The patient's previous history of abdominal radiotherapy may have increased her risk of intestinal pneumatosis, hence increasing the susceptibility to infection.

Learning points

- ▶ The presentation of pneumatosis intestinalis with HPVG is most commonly caused by intestinal ischaemia, and this carries a high mortality rate.
- ▶ The differential diagnosis for pneumatosis intestinalis and HPVG includes bowel ischaemia, anastomotic leak, hollow-viscus perforation and intra-abdominal collection with sepsis secondary to gas-forming organisms.
- ▶ Treatment of HPVG and pneumatosis intestinalis with hyperbaric oxygen therapy may be beneficial.
- ▶ When deciding the management of a patient with pneumatosis intestinalis and HPVG, the clinical picture of the patient and the risks versus benefits of surgery must be balanced.

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