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Abstract

Introduction: Pneumatosis intestinalis and presence of hepatic portal venous gas are traditionally recognised as ominous signs, often associated with intestinal ischaemia. However, it had also been found that it is associated with other pathologies.

Cases review and case series: Pneumatosis intestinalis is reviewed in this article and two patients who presented with this condition are discussed. The salient related literature is also reviewed.

Conclusions: Pneumatosis intestinalis and hepatic portal venous gas findings on CT do not always signify mesenteric ischaemia requiring surgical intervention with emergency laparotomy. Decision to operate should not be made solely on the basis of CT findings. Consideration should be broadened to include other potential diagnoses.

Key Words

Pneumatosis Intestinalis; Hepatic Portal Venous Gas; Bowel Ischaemia

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Introduction

Pneumatosis intestinalis and presence of hepatic portal venous gas are traditionally recognised as ominous signs, often associated with intestinal ischaemia. Patients may usually require laparotomy due to the risk of fatal outcome if left untreated.¹

The incidence of pneumatosis intestinalis in the general population is around 0.03% based on autopsy series²; however, the number of cases seen appear to be increasing, most probably due to increased sensitivities of computed tomography (CT) technology.³⁻⁵ Consequentially, findings of pneumatosis intestinalis and hepatic portal venous gas are increasingly being identified in a spectrum of conditions, both surgical and non-surgical.^{6,7}

In current literature, evidence for the attribution of pneumatosis intestinalis and hepatic portal venous gas to a cause other than bowel ischaemia remains scarce.⁸ McGregor A *et al* reported a case of a patient found to have both pneumatosis intestinalis and hepatic portal venous gas, but yielded negative result for ischaemic bowel following an exploratory laparotomy.¹ Lisa MH *et al* give examples in their review of various medical and surgical conditions associated with secondary causes of pneumatosis intestinalis and hepatic portal venous gas seen on

CT imaging.⁹ Amongst life-threatening conditions such as ischaemic colitis, consideration is given to benign associations such as pulmonary diseases, systemic complications of rheumatological diagnosis, iatrogenic causes such as certain medications, and various intestinal disorders.

The benign and life-threatening causes of secondary pneumatosis intestinalis are tabulated overleaf.

Shawn *et al*⁶ reports four cases of pneumatosis intestinalis with different spectrum. Two of these cases were managed conservatively. The first of these patients underwent CT which reported evidence of pneumatosis intestinalis and portal venous gas. This patient was discharged from the hospital without a definite diagnosis. The second patient had a background history of CREST (scleroderma with subcutaneous calcinosis, Raynaud phenomenon, oesophageal dysfunction, sclerodactyly, and telangiectasia) and chronic intestinal pseudo-obstruction with bacterial overgrowth. This patient again was treated conservatively with bowel rest and was discharged without any complications.

The third case involved a patient with background history of ulcerative colitis, admitted with diffuse

Benign Causes of Secondary Pneumatosis Intestinalis					
Pulmonary	Intestinal	Iatrogenic	Medications	Systemic	Transplant
Asthma	Pyloric Stenosis	Barium enema	Corticosteroids	Scleroderma	Bone marrow
COPD	Peptic Ulcers	Jejunioileal by-pass	Chemotherapy agents	Systemic lupus	Kidney
Cystic Fibrosis	Pseudo-obstruction	Jejunostomy tubes	Lactulose	AIDS	Liver
Pulmonary Fibrosis	Enteritis	Post-surgical anastomosis	Sorbitol	Rheumatoid arthritis	Cardiac
PEEP	IBD	Endoscopy			Lung
Life-Threatening Causes of Secondary Pneumatosis Intestinalis					
Intestinal Ischaemia		Toxic megacolon		Ingestion of corrosive agents	
Mesenteric vascular disease		Trauma		Intestinal obstruction/strangulation	
Collagen vascular disease		Organ transplantation		Inflammatory conditions	

Table 1: Causes of Pneumatosis Intestinalis, adapted from Lisa MH et al.

abdominal pain cramping in nature and associated with bloody stool. This patient was initially treated conservatively, however deteriorated and was advised to undergo proctocolectomy and ileal J-pouch-to-anal canal anastomosis with loop ileostomy. In this patient, the CT findings demonstrated extensive pneumatosis coli of the ascending colon and a pneumoretroperitoneum extending superiorly into the porta hepatis at the level of the inferior vena cava and duodenum. The last patient in this case series was a patient with background history of COPD who had a coronary bypass surgery and suffered from pulmonary complications and worsening of sepsis. A CT scan demonstrated extensive colonic pneumatosis, an air-fluid boundary in the superior mesenteric vein, copious portal venous gas, and bilateral renal infarcts. Treatment was withdrawn after discussion with the patient's family.

Review of Cases:

We are reporting two cases of patients with extensive abnormal CT findings of pneumatosis intestinalis and hepatic portal venous gas, with consideration of their clinical presentations and outcomes.

Case 1:

A 74 year old gentleman with a background history of advanced dementia, myocardial infarction, hypertension and hypercholesterolaemia was admitted with a 4 day history of generally felling unwell with several episodes of vomiting of dark green content. There was no history of

haematemesis, rectal bleed or melena. Upon clinical examination the patient had a soft and mildly distended abdomen and generalised tenderness. No hernias or masses were identified.

Initial investigations demonstrated a dehydrated patient with a urea of 20.1 mmol/L and a normal full blood count. Venous blood gas showed a pH was 7.49 with a lactate of 2.5 mmol/L. Chest x-ray was unremarkable and abdominal x-ray showed multiple distended small bowel loops.

The initial impression was small bowel obstruction. After initial resuscitation, the patient had a CT scan the same day, which was reported as:

"Generalised ischaemia of bowel and stomach with air seen in the stomach and bowel wall. Air is also seen in left intrahepatic portal vein. This raised the high suspicion of perforated appendix and secondary bowel obstruction with mural ischaemia." (Figures 1-3)

Despite the extensive CT report, the patient was not offered any surgery due to his multiple comorbidities and the fact that he was clinically stable. The patient opened his bowels without any problems. He experienced intermittent spiking of temperature and tachycardia, however his abdomen continued to improve throughout the stay in the hospital.

A follow up CT scan performed four days after hospitalisation showed: "Persistent distension of

small bowel loops without convincing evidence of pneumatosis intestinalis, and persistent stomach distension without any evidence of intramural gas. Previously described gas in portal vein had almost completely disappeared. Two collections were noted in right lower abdominal quadrant and right hemi-pelvis measuring 5.1 x 8.1 x 8.5cm and 5.3 x 5.2 x 10cm, and had progressed since CT four days ago."

The patient was started on combination of nasogastric feeding and total parental nutrition due



Figures 1-3: CT findings Demonstrated Air within Stomach, Bowel Walls and Intrahepatic Portal Vein

to poor oral intake.

A further CT scan was performed eighteen days from admission which showed: "Gas in stomach wall and bowel had now resolved. Gas previously seen in intrahepatic portal vein had also now resolved. Collections previously seen in right lower abdomen tracked to the right psoas muscle resulting in psoas abscess."

CT guided drainage was proposed; however the patient was considered high risk for sedation, therefore this therapeutic option was abandoned. The patient was treated with intravenous antibiotic instead.

The patient acquired a few nosocomial infection such as hospital acquired pneumonia, peripherally inserted central catheter (PICC) line infection and urinary tract infection. These were treated with the appropriate antibiotic.

One month following admission, a fourth CT scan showed: "Right iliac fossa abscess and psoas abscess reducing in size and resolving pneumonia."

Seven weeks following admission, the patient was considered to have had significant clinical improvement and nasogastric feeding was stopped.

The patient underwent another CT scan on the 53rd day of admission which showed: "Significant reduction in right sided psoas abscess."

The patient was discharged after two months of hospitalisation and had a final CT scan two months post discharge which showed complete resolution of previous collections.

The conclusion from the case was pneumatosis intestinalis and hepatic portal venous gas unrelated to bowel ischaemia.

Case 2:

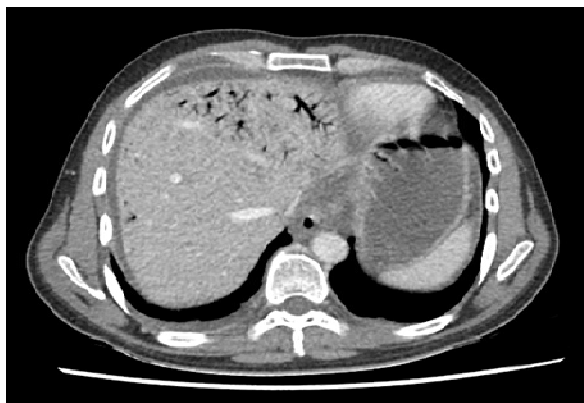
A 52 year old gentleman presented with a three day history of generalised abdominal pain, several episodes of dark brown vomitus, and passing black tarry stools. The patient denied any rectal bleeding and was otherwise previously fit and well, with past history of schizophrenia and epilepsy. Examination demonstrated a distended abdomen without guarding, with evidence of widespread tenderness and sluggish bowel sounds. All observations were within normal parameters, with exception of tachycardia at 140/min.

Initial investigations revealed raised inflammatory markers (white cell count $18.2 \times 10^9/L$ and neutrophil count $15.3 \times 10^9/L$). Liver and renal profile were normal. An arterial blood gas revealed

pH of 7.51 and normal lactate (1.0 mmol/L). Plain abdominal radiograph demonstrated multiple dilated small bowel loops.

The patient was commenced on initial resuscitation with intravenous fluid, antibiotic, and catheterisation. An urgent CT of abdomen and pelvis was reported as:

"Pneumatosis of bowel walls; air within the stomach wall and portal venous system; bowel necrosis



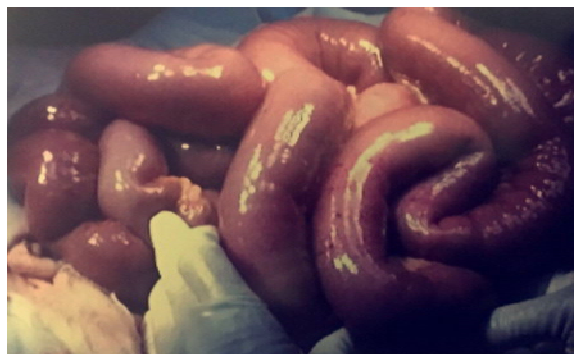
Figures 4-5: *Pneumatosis of Bowel and Stomach Walls*

throughout." (Figures 4-5)

A P-Possum score showed mortality at 43.3% and morbidity at 96.9%. In light of the CT findings and potential for fatal outcome left untreated, the patient was consented and taken to theatre to undergo an emergency laparotomy.

Remarkably, intra-operatively the small bowel was found to be well perfused with no signs of ischaemia

and there were no free air noted. The ascending and transverse colon were found to be distended,



Figures 6: *Intra-operative Findings of Healthy, Well Perfused Bowel with Intact Mucosa*

and a collapsed descending colon. (Figure 6)

Post-operatively the patient received ward-based care and was treated for surgical ileus, and did not require any intensive care input.

Oesophageoduodegastroscopy (OGD) was done to investigate the melena and haematemesis and was reported as normal. He was discharged from hospital after approximately three weeks of ward level treatment of surgical ileus.

Conclusion

Pneumatosis intestinalis and hepatic portal venous gas findings on CT do not always signify mesenteric ischaemia requiring surgical intervention with emergency laparotomy. Decision to operate should not be made solely on the basis of CT findings. Consideration should be broadened to include other potential diagnoses. Further retrospective observation studies should be conducted to improve understanding of the differential diagnoses which could attribute to such findings on CT scans.

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