Pneumoperitoneum without peritonitis

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Summary: We present our experience with 5 patients, all of whom were noted to have radiological signs of pneumoperitoneum in the absence of clinical features of peritonitis. All 5 cases were eventually shown to be due to causes not requiring surgery. We review the numerous unusual causes of pneumoperitoneum which do not require urgent surgical intervention and emphasize their importance in cases where the absence of signs of peritonitis may cause diagnostic difficulty.

Introduction

Gastrointestinal perforation accounts for 90% of cases of pneumoperitoneum when post-operative causes are excluded.¹ There are, however, numerous other causes of pneumoperitoneum^{2–4} and when patients with these conditions present there is often diagnostic difficulty. This group of patients without peritonitis must be differentiated from those with peritonitis in whom the clinical signs are masked. We present the case histories and radiological findings in 5 patients with pneumoperitoneum without signs of peritonitis and highlight the causes of 'benign' pneumoperitoneum.

Case reports

Case 1

A 34 year old woman presented complaining of intermittent abdominal pain and diarrhoea over a 2 week period. Physical examination revealed mild generalized abdominal tenderness but was otherwise normal. Chest and abdominal radiographs demonstrated pneumoperitoneum (Figure 1). A provisional diagnosis of visceral perforation was made but as overt signs of peritonitis were absent the patient was treated conservatively. The abdominal radiographs were subsequently interpreted as typical of pneumatosis cystoides coli. Barium enema confirmed the diagnosis (Figure 2). Her symptoms resolved on conservative treatment and the pneumoperitoneum resolved within 10 days.

Figure 1 Case 1: chest radiograph showing large pneumoperitoneum. Gas filled cysts in the wall of the splenic flexure (arrows) were not recognized initially.

Case 2

A 60 year old woman with severe chronic obstructive airways disease presented with a 2-day history of lower abdominal pain. On examination there was mild abdominal tenderness but no other abnormality. Chest and abdominal radiographs demonstrated a large amount of air under the diaphragm (Figure 3). Visceral perforation was suspected but she was treated conservatively because of the absence of signs of peritonitis. Radiological and endoscopic examinations of the

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Figure 2 Case 1: barium enema showing submucosal and subserosal gas-filled cysts typical of pneumatosis cystoides coli are seen in the descending colon (arrows).

Figure 4 Case 2: small bowel barium meal. Gas cysts (arrows) are interspersed between the valvulae conniventes of the jejunum.

Figure 3 Case 2: chest radiograph shows a large pneumoperitoneum (arrows) and changes of chronic obstructive airways disease.

oesophagus, stomach, duodenum and colon were normal. Subsequently a small bowel barium examination demonstrated gas filled cysts in the wall of the jejunum and ileum typical of pneumatosis cystoides intestinalis (Figure 4). These cysts were recognized in retrospect on the initial plain abdom-

inal films. Although the patient's symptoms resolved spontaneously, free subdiaphragmatic gas persisted for 14 months after the initial presentation.

Case 3

A 46 year old man with acute myeloid leukaemia underwent autologous bone marrow transplantation. Five weeks post-transplantation he developed intermittent diarrhoea, colicky lower abdominal pain and a pyrexia of 38°C. Abdominal examination was normal. Cultures of faeces, urine, blood, sputum and swabs from his oral cavity were normal. Radiographs of his chest and abdomen demonstrated pneumoperitoneum and features of pneumatosis cystoides intestinalis and coli. This was confirmed with contrast studies. The pneumoperitoneum and pneumatosis resolved spontaneously and he remains well 8 months later.

Case 4

A 13 year old boy was admitted with an extensive staphylococcal pneumonia and required ventilation. While being ventilated, extensive pneumoperitoneum was noted on chest radiographs. There were no clinical signs of perforation and the presence of pneumomediastinum and retroperitoneal gas on the same radiographs confirmed that air was tracking into the peritoneal cavity via the mediastinum and retroperitoneal spaces (Figure 5). There was no evidence of pneumatosis intestinalis on the plain films. The pneumoperitoneum resolved quickly when ventilation was discontinued.

Figure 5 Case 4: chest radiograph showing pneumomediastinum (large arrow), pneumoperitoneum (small arrows) and retroperitoneal air (curved arrows). Much of the free intraperitoneal gas lies in front of the liver on this supine film. There is collapse of the right lung with abscess formation.

Case 5

A 30 year old woman presented for elective investigation of right upper quadrant pain. She was asymptomatic at presentation but an abdominal radiograph unexpectedly showed free intraperitoneal gas. This was confirmed on an erect chest film. Physical examination was entirely normal. She was admitted for observation. A more detailed history subsequently revealed that she had had orogenital intercourse 12 hours before the radiographs were taken. The pneumoperitoneum resolved within 4 days. No cause was found for her original symptoms.

Discussion

In surgical practice, pneumoperitoneum commonly occurs following gastrointestinal perforation or as residual air following laparotomy. There is, however, an increasing number of causes of

pneumoperitoneum that do not require urgent surgical intervention but which, nonetheless, may cause diagnostic confusion and possibly result in unnecessary laparotomy (Table I). All the patients described in this report caused initial diagnostic difficulty and a surgical opinion was sought with a view to laparotomy. The absence of signs of peritonitis led to appropriate conservative management in all cases.

Three of our patients developed pneumoperitoneum secondary to pneumatosis cystoides of small (intestinalis) or large (coli) bowel. This is a well recognized but curious condition in which gas cysts form in the subserosa or submucosa of the bowel wall as either a primary idiopathic phenomenon or secondary to a number of causes including chronic obstructive airways disease, asthma, proximal bowel distension (e.g. pyloric stenosis) and small bowel disease (e.g. scleroderma and Whipple's disease).⁸⁻¹⁰

The mechanisms giving rise to pneumatosis cystoides are disputed. Raised intra-thoracic pressure, due to bouts of coughing, vomiting or ventilation in the presence of obstructive airways disease, has been purported to give rise to local intra-thoracic pulmonary interstitial emphysema with subsequent spread of air to the mediastinum and retroperitoneum and, eventually, into the bowel

Table I Causes of pneumoperitoneum

<i>A. Pneumoperitoneum with peritonitis</i>	
Perforated viscus	
Necrotizing enterocolitis	
Bowel infarction	
Penetrating abdominal injuries	
<i>B. Pneumoperitoneum without peritonitis</i>	
Thoracic causes	
Positive pressure ventilation	
Pneumomediastinum/pneumothorax	
Chronic obstructive airways disease	
Asthma	
Abdominal causes	
Post laparotomy	
Pneumatosis cystoides coli/intestinalis	
Jejunal diverticulosis	
Endoscopy	
Paracentesis/peritoneal dialysis/laparoscopy	
Bone marrow transplantation	
Female pelvic causes	
Instrumentation (e.g. hysterosalpingography, rubin's test)	
Pelvic examination (esp. post-partum)	
Post-partum knee-chest exercises ⁵	
Oro-genital intercourse ⁶	
Vaginal douching ⁶	
Coitus	
Water-skiing ⁷	

wall via the mesentery.¹¹ This forms gas-filled cysts which cause pneumoperitoneum without peritonitis, either by rupture or diffusion.^{2,12} More recently, Pieterse *et al.*¹³ have demonstrated colonic histopathological changes supporting a local low grade inflammatory process which they propose as an initiating factor.

Pneumatosis cystoides intestinalis or coli may be asymptomatic or present with intermittent colicky abdominal pain, diarrhoea and occasionally blood per rectum.^{13,14} The 3 cases with pneumatosis in our series are typical in this regard. The condition most frequently involves the left hemicolon and may be diagnosed by recognition of the submucosal cysts on plain radiographs, in contrast studies or at sigmoidoscopy. The cysts are less frequently confined to the small bowel when they are more difficult to identify on plain radiographs (case 2). The condition may resolve spontaneously, as in our cases, although both encysted or free gas may persist for some time. Treatment with hyperbaric oxygen and antibiotics has been successful although the condition often recurs.^{15,16}

Pneumoperitoneum in association with pneumatosis intestinalis occurring in immunosuppressed patients presents a particular diagnostic problem. Day *et al.*¹⁷ reported the development of pneumatosis intestinalis in 18 patients following bone marrow transplantation. Four of these patients subsequently developed pneumoperitoneum or retroperitoneal gas and one of the patients required a laparotomy for perforation. The other 3 were treated conservatively and were alive at 6 months follow up. The cause of pneumatosis is thought to be due to atrophy of lymphoid follicles in the bowel wall after high dose steroid therapy.¹⁸ Gas-filled cysts develop where the mucosa has become thinned. Mucosal atrophy secondary to systemic chemotherapy or irradiation prior to bone marrow transplantation may also be contributing factors. A similar pattern of intramural bowel gas may develop in immunosuppressed patients with severe enteric infections and bowel infarction. Day *et al.*¹⁷ noted 7 such patients in which pneumatosis developed within the clinical context of multiorgan failure and shock, all of whom died. The clinical

signs of multiorgan failure and shock allow the differentiation between this group and the group typified by our patients with pneumatosis and benign pneumoperitoneum. However, it must be stressed that the signs of peritonitis may be minimal or absent in immunosuppressed patients and a diagnosis of 'benign' pneumoperitoneum should be accepted with caution.

The development of pneumoperitoneum in a patient on a ventilator is always of great concern. Such patients are invariably ill with a greater risk of gastrointestinal perforation. Tracking of air from the mediastinum into the retroperitoneum and peritoneal cavity is well recognized.¹⁹ The detection of pneumomediastinum and retroperitoneal air in a patient with pneumoperitoneum on a ventilator allows recognition of positive pressure ventilation as the underlying cause. Ventilation associated pneumoperitoneum has been most frequently reported in neonates with respiratory distress syndrome²⁰ but has also been reported as a cause of unnecessary laparotomy in adults.²¹

The female genital tract provides a portal of entry for air into the peritoneal cavity. This is particularly likely to occur in the early post-partum period and numerous causes have been reported (Table I). Case 5 of our series emphasizes the value of a detailed history when pneumoperitoneum develops in a female patient without obvious cause or evidence of peritonitis. Our patient was atypical in that she was neither pregnant nor in the post-partum period at the time of presentation.

In summary, pneumoperitoneum is an important radiological finding and in each case perforation of a viscus must be considered. If there are no supporting clinical features of peritonitis, a careful history and search for radiological evidence of pneumatosis cystoides, pneumomediastinum, pneumothorax or retroperitoneal air may point to a benign cause and reduce the risk of unnecessary laparotomy.

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