Abdominal *x* rays made easy: abnormal extraluminal gas

This month, in the third part of our series on abdominal radiographs, **Ian Bickle** and **Barry Kelly** look at identifying abnormal extraluminal gas on plain abdominal films

Extraluminal gas is gas outside the sealed gastrointestinal tract.

Pneumoperitoneum

A most important and potentially devastating finding is that of free intraperitoneal gas, which is known as pneumoperitoneum. Emergency surgical intervention is likely to be necessary, as pneumoperitoneum usually indicates a perforated viscus. The supplementary plain radiograph should be an erect chest radiograph that visualises gas collecting beneath the diaphragm. Depending on the volume of gas in the peritoneum, it may be apparent under one or both hemidiaphragms. As you may recall from the first part of the series (normal radiographs) a gastric air ("gas") bubble is usually seen in the left hypochondrium on the erect film. This can make distinguishing free air on this side problematic. For this reason, identification of free gas on the right side is more straightforward. The air is trapped between the underside of the diaphragm and the upper surface of the liver (fig 1). A small volume of gas has a crescentic appearance.

Should a supine abdominal radiograph be the only film available—if, for example, the patient is too ill to undergo an erect chest radiograph—there are radiological

Conditions causing extraluminal air

Perforated abdominal viscus
Abscesses (subphrenic and other)
Biliary fistula
Cholangitis
Pneumatosis coli
Necrotising enterocolitis
Portal pyaemia

Fig 1. Gross pneumoperitoneum with free air under both hemidiaphragms. In addition there is a large dark egg shape projected through the heart. This is a large, fixed, hiatus hernia—an incidental finding, but one which shows an abnormal air collection

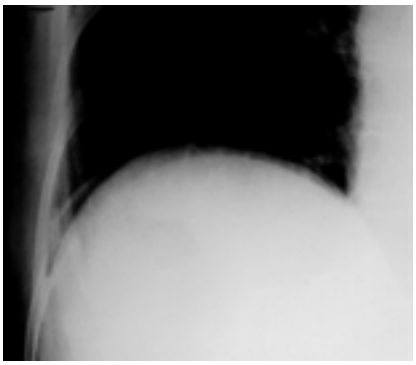

Fig 2. A subtle pneumoperitoneum

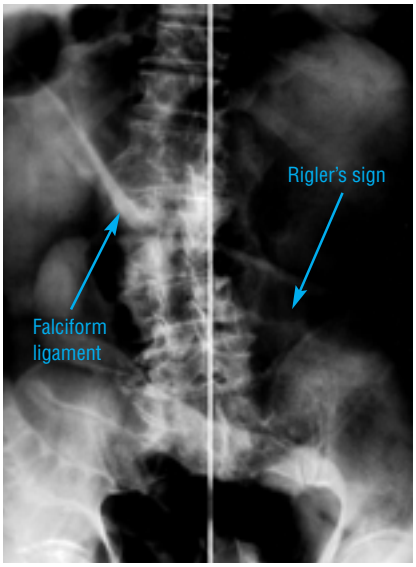

Fig 3. Falciform ligament (left) and Rigler's sign (right) dark triangles outlined by the bowel wall serosa

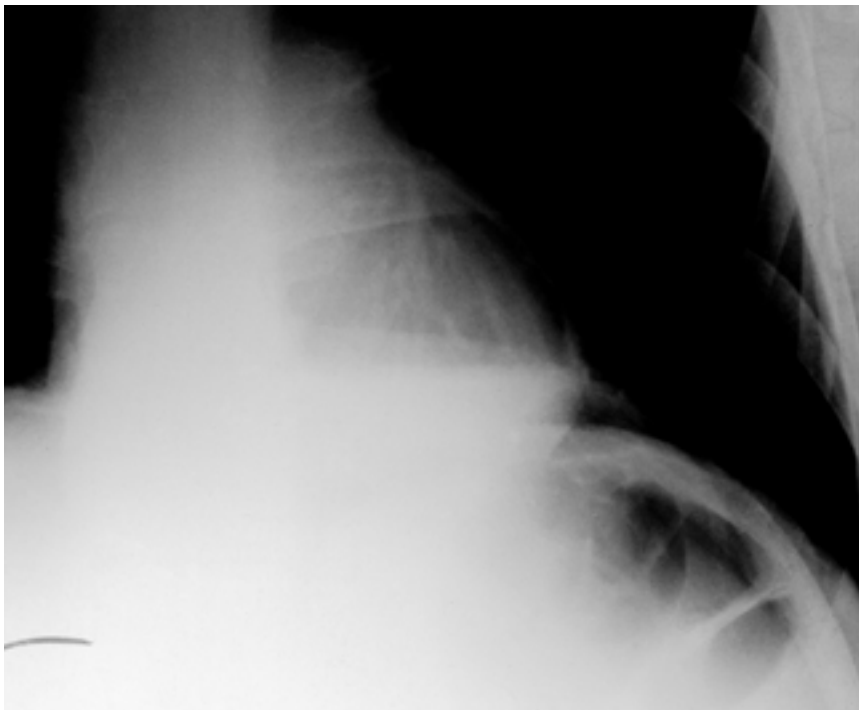

Fig 4. Chilaiditi's sign

signs that help identify free gas on the radiograph. The falciform ligament sign is seen when free air outlines the falciform ligament, identified as a thin straight line starting in the right upper quadrant, where it originates, and ending near the umbilicus, where it terminates (fig 2). In Rigler's sign, gas can be seen on both sides of the bowel wall (fig 3). This makes the serosal surface of the bowel easily visible.

Chilaiditi's syndrome

Chilaiditi's syndrome is an important normal variant on the erect chest radiograph, which must be distinguished from pathological free gas under the diaphragm. In this phenomenon, gas is seen between the hemidiaphragm and the liver or spleen (fig 4). On close and careful observation this should be identified as gas filled large bowel, most likely transverse colon (apparent, as haustra are seen within the gas filled structure). This gas is still contained in the bowel loop.

Subphrenic abscess

This is a localised collection of free gas and fluid, which usually forms under the right hemidiaphragm, above the solid liver. This gas collection usually occurs above the 11th rib (fig 5).

Biliary gas

On the plain abdominal *x* ray film, gas is not normally identified in the biliary system, either intra- or extrahepatic. There are, however, situations when gas might be seen as branching "tree-like" streaks of black projected in the liver shadow. After endoscopic retrograde cholangiopancreatography with sphincterotomy, gas may travel from the duodenum into the biliary tree as the sphincter of Oddi in the second part of the duodenum is incompetent. Similarly, after a gallstone has been passed, the sphincter may become dilated. Biliary fistulas are less common but may develop with a gallstone ileus. Fistulation between the gallbladder and adjacent bowel allows a route for gas into the biliary system. The final aetiology is cholangitis. If the biliary ducts are infected with gas forming organisms, gas will be produced, and contained, in the ducts, effectively creating a negative contrast to the surrounding soft tissue of the liver.

Miscellaneous causes

The final causes of extraluminal gas are conditions where gas has escaped from the lumen of the gastrointestinal tract but remains within the bowel wall; this is known as intramural gas. This gas may migrate to the portal vein and is effectively an "ante mortem" sign, except in the case of neonatal necrotising enterocolitis.

Necrotising enterocolitis is a condition seen in premature babies when gas "leaks" into the bowel wall.

In bowel wall infarction, abscesses may form, which produce gas contained in the bowel wall.

Pneumatosis coli, a condition where blebs of gas form on the bowel wall, is of obscure aetiology and makes the bowel wall look like "bubble wrap." These blebs may rupture to produce a pneumoperitoneum.

Ian C Bickle *final year medical student,* Queen's University, Belfast

Barry Kelly *consultant radiologist* *medicine@totalise.co.uk,* Royal Victoria Hospital, Belfast

Next month: Calcification

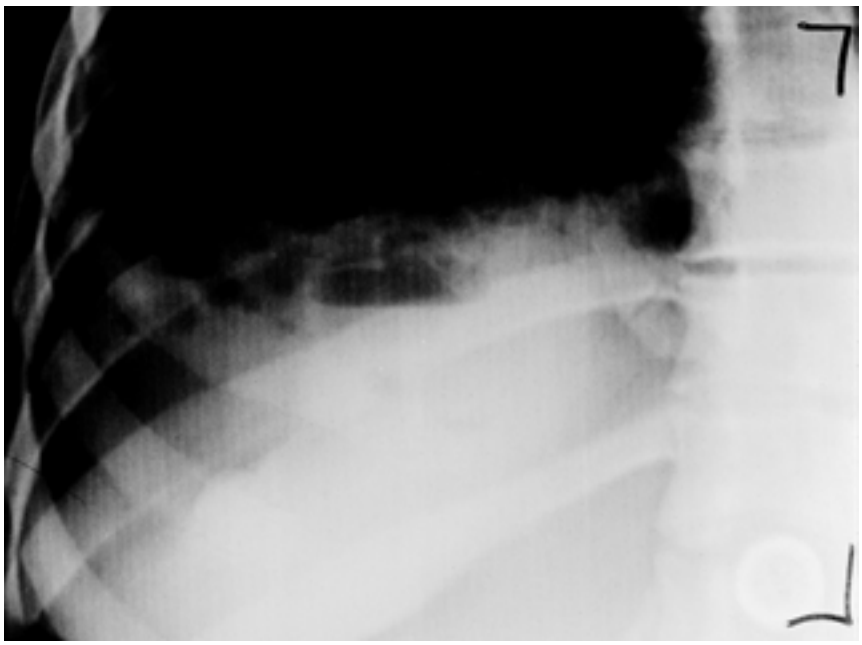

Fig 5. Subphrenic abscess