Clinics in Diagnostic Imaging (53)

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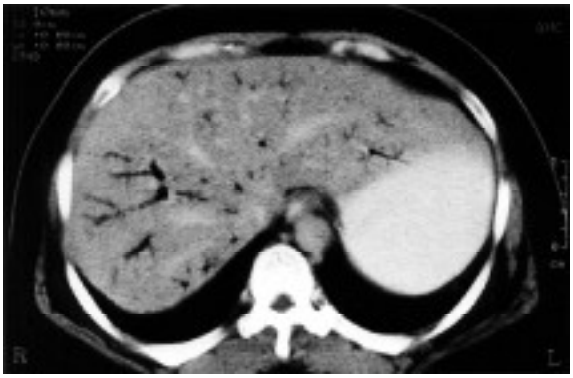

Fig. 1a Enhanced CT scan of the abdomen taken at the level of the upper liver.

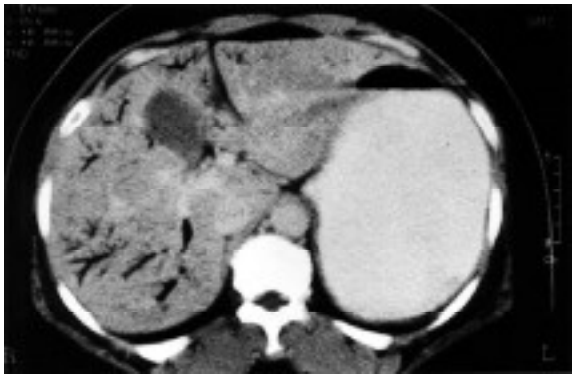

Fig. 1b Enhanced CT scan of the abdomen taken 3 cm caudal to Fig. 1a.

CASE PRESENTATION

A 43-year-old woman presented with left upper abdominal pain for one day. She had associated nausea and vomiting. On physical examination, she was noted to be obese and afebrile. Her vital signs were stable. She was tender over the left side of her upper abdomen, with positive rebound. Bowel sounds were reduced. Basic laboratory investigations revealed normal urea and electrolyte levels, haemogloblin of 15.3 g/dL, and raised leucocytes of 20.7 x 10^9/dL (neutrophils 72%, lymphocytes 26%, monocytes 2%). Electrocardiography was normal. Abdominal radiographs showed multiple distended small bowel loops, consistent with ileus, and suggestion of faint linear hypolucencies in the right upper quadrant. What do computed tomography (CT) scans of the upper abdomen (Figs. 1a-b) show? What is the diagnosis?

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IMAGING INTERPRETATION

CT scans of the upper abdomen (Figs. 1a-b) showed numerous hypodense branching structures throughout the parenchyma of both lobes of the liver. These structures had CT density similar to that of gas and extended to the subcapsular region of the liver. They lay within the branches of the opacified portal vein. There was no evidence of intra-hepatic ductal dilatation.

DIAGNOSIS

Hepatic portal venous gas due to mesenteric infarction

CLINICAL COURSE

At laparotomy, extensive bowel gangrene was found. The involved segment extended from the proximal jejunum, 10 cm distal to the ligament of Trietz, to the mid-transverse colon. 1000 ml of serosanginous fluid was found in the peritoneal cavity. The jejunum, ileum, and proximal hemicolon were resected. A transverse colostomy was performed. The cause of bowel gangrene was superior mesenteric artery (SMA) occlusion. The patient made an uneventful post-operative recovery. However, she subsequently developed a short bowel syndrome, and was relatively well when seen on follow-up after eight months.

Fig. 2 Abdominal radiograph of a 4-day-old male infant with necrotising enterocolitis. Branching tubular lucencies extending nearly to the liver periphery are seen.

Fig. 3 62-year-old woman with pneumobilia. The intra-biliary branching gas pattern is located at the liver hilum.

DISCUSSION

The presence of hepatic portal venous gas (HPVG) is a rare radiological sign and was first described in infants in 1955[1]. This finding is associated with a poor prognosis, with a mortality rate of 75%-85%, depending on aetiology[2,3]. HPVG has been long recognised to be due to extensive bowel necrosis, most commonly ischaemic bowel disease in adults and necrotising enterocolitis in infants. Other reported causes include umbilical vein catheterisation in infants, diverticulitis, inflammatory bowel disease, intraabdominal sepsis, pneumatosis intestinalis, haemorrhagic pancreatitis, acute gastric distension, air embolus during double contrast enema performed in inflammatory bowel disease, and blunt abdominal trauma[4,5].

The exact pathophysiology of HPVG is still unclear. One theory is that mechanical bowel distension with mucosal damage enables gas to directly enter the mesenteric vessels[1,6,9]. The other major theory is that gas-forming organisms penetrate the mesenteric veins to reach the portal system[10]. There is a trend towards classification of HPVG into two groups. The majority of cases fall into the severe or life-threatening group where there is transmural bowel ischaemia, intramural gas, systemic toxicity and a high mortality rate. The second benign group comprises cases without intestinal ischaemia nor infection. Raised intraluminal pressure associated with mucosal disruption is however present in this group of patients[11,12].

HPVG can be diagnosed by radiography, ultrasonography and CT[13-15]. On radiographs, HPVG is seen as tubular lucencies branching from the porta hepatis to the edge of the liver (Fig. 2). The lucencies are due to centrifugal flow of portal vein blood to the liver periphery, with resultant accumulation of gas. This finding can be differentiated from pneumobilia in which the bile flow is centripetal. Biliary gas tends to collect near the liver hilum and does not come to within 2 cm of the liver capsule[3,13] (Fig. 3). HPVG is demonstrated on ultrasonography as highly echogenic bubbles within the branches of the portal vein (Fig. 4a). Colour Doppler flow studies show movement of echogenic spots within the blood stream

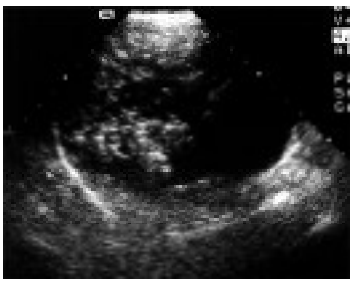

Fig. 4a 85-year-old woman with HPVG. Liver ultrasonogaphic scan shows multiple hyperchoic foci scattered within the portal veins. These foci extend to a subcapsular location.

Fig. 4b Same patient as Fig. 4a. Enhanced CT scan taken at the level of the upper liver. There are numerous branching hypodense areas within the portal vein branches in the left lobe of the liver. They extend to a subcapsular location.

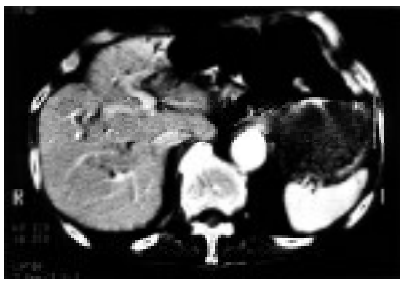

Fig. 4c Same patient as Figs. 4a-b. Enhanced CT scan taken at the level of the mid-liver. Gas is present within the opacified branches of the right portal vein.

and vertical bidirectional aberrations on the frequency spectrum[14,16-18].

Colour Doppler flow ultrasonography and CT are more sensitive than radiography for the detection of HPVG. CT is however the most suitable method for identifying the underlying cause of HPVG[19]. The characteristic CT findings are peripheral, subcapsular branching hypodensities (Figs. 4b-c). As portal venous blood may obscure small amounts of HPVG, unenhanced CT scans should be performed first[19-21]. Establishing the diagnosis of HPVG or mesenteric venous gas requires selection of optimal window parameters. The CT window may need to be widened and the window level centered closer to that of fat in order to make the difference in density between fat and gas more conspicious[21].

In summary, HPVG is not a disease but a rare imaging feature found in a variety of serious conditions. Faberman and Mayo-Smith have shown that HPVG itself is not a predictor of mortality, with a mortality rate of only 29% in 17 patients with HPVG on CT. The authors concluded that the more relevant prognosticator is the clinical context in which the HPVG occurs. The finding of HPVG on radiography carries a more severe prognosis compared to when it is found on CT[21]. Careful clinical evaluation and the appropriate therapeutic action are therefore important when HPVG is detected on imaging.

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ABSTRACT

A 43-year-old woman presented with acute abdominal pain and signs of ileus. CT scan of the abdomen showed hepatic portal venous gas. At surgery, a long segment of gangrenous bowel extending from the jejunum to the proximal hemicolon was found. The cause was superior mesenteric artery occlusion. The aetiology, imaging features and clinical significance of hepatic portal venous gas are discussed.

Keywords: Computed tomography; Hepatic portal venous gas; Intramural gas; Mesenteric infarction; Pneumatosis intestinalis

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