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● *Original Contribution*

HEPATIC PORTAL VENOUS GAS IN ULTRASONOGRAM—BENIGN OR NOXIOUS

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Abstract—The purpose of this study was to investigate and differentiate the characteristics of benign hepatic portal venous gas (HPVG) and noxious HPVG on sonographic images. This study included seven patients (age 65 to 89 y; mean 75 y) with sonograms and computed tomography (CT) images performed within 4-h interval. The sonographic findings of HPVG could be categorized into three patterns: (1) dot-like pattern in two patients; (2) streak-like pattern in three patients; and (3) fruit-pulp-like pattern in two. In the cases of dot-like pattern, it is of a benign transient situation; this phenomenon may be only demonstrated on sonograms but not necessarily on CT. The prognosis is more favorable and any subsequent CT may not be required. In the cases of streak-like or fruit-pulp-like patterns without localized liver lesions (*e.g.*, abscess), it usually indicates a noxious scenario with worse clinical sequelae. We concluded that the identification of sonographic patterns of HPVG might be important to predict patient's outcome. (E-mail: hlliang@vghks.gov.tw) **© 2007 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Portal venous gas, Pattern of gas, Amount of gas, Ultrasonography, Computed tomography.**

INTRODUCTION

Hepatic portal venous gas (HPVG) is an unusual feature that is induced from a variety of abdominal entities. The causes of HPVG include mesenteric infarction, intestinal obstruction, abdominal abscess, neonatal necrotizing enterocolitis, Crohn disease, ulcerative colitis, diverticulitis, perforated gastric carcinoma or ulcer, suppurative cholangitis and caustic ingestion (Fred et al. 1968; Liebman et al. 1978; Gosink et al. 1981). The pathogenesis of gas in the portal vein is thought to be (1) gas infiltrates directly through the damaged intestinal wall into small intestinal venules in patients with bowel obstruction or bowel wall ulcers and, thus, into the portal vein and (2) bacteria traverses the intestinal wall, which is already damaged by an underlying disease and, then, producing gas in portal vein (Grendell et al. 1989; Lafortune et al. 1991).

Early reports of the mortality rates of portal venous gas approached 90% (Fred et al. 1968), whereas 29% lower mortality rates were reported in recent studies (Faberman et al. 1997). The decline was due to the recognition of an increasing number of clinically unimportant causes of HPVG such as ileus, gastric dilation, barium enema examination, colonoscopy, liver transplantation, pulmonary disease, seizure and trauma (Brown et al. 1999). Therefore, HPVG, *per se*, does not necessarily imply a threatening situation. Instead, the prognosis is mainly determined by the causing entities resulting in HPVG. Thus, it is of high value if we are able to draw more information of the causing entities from the imaging characteristics. In reviewing the literature, only limited references to the sonopictures of HPVG were found (Kriegshauser et al. 1990; Nguyen et al. 1998; Maher et al. 2001; Patrick et al. 2002; Kalb et al. 2003; Chiu et al. 2005). Although the significances of HPVG had been reported (Bloom et al. 1990; Schulze et al. 1995; Carmen et al. 2000; Lien et al. 2004; Sato et al. 2005), there was no mention to the sonographic patterns of HPVG and its relations to the clinical prognosis. In this study, we described the various sonographic patterns of HPVG to differentiate transient and persistent HPVG in relation to the clinical prognosis.

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MATERIALS AND METHODS

A retrospective search of abdominal sonography and computed tomography (CT) examinations at our hospital between January 2000 and December 2005 revealed HPVG phenomenon in 16 patients. Of them, seven patients had both sonograms and CT studies performed within 4-h interval; the other nine patients had CT images only. All the authors were responsible for the daily operations and reporting of the sonograms and abdominal CT. The age, gender, the reason for requesting sonography, the causes of HPVG, the appearances of gas distribution, follow-up CT pictures and prognosis of patients were reviewed.

We described three sonographic patterns of HPVG as (1) dot-like pattern: centrifugal movable, echogenic-spot particles with branched distribution in both lobe of liver, yet most liver parenchyma could be still observed (Fig. 1).; (2) streak-like pattern: echogenic gas shadow with short streak-like distribution extending to peripheral liver, but not reaching the liver capsule (Fig. 2). (This streak-like pattern showed left lobe predominant, yet right lobe parenchyma was still well observed.); and (3) fruit-pulp-like pattern (like the cross-section of a citrus): echogenic gas shadow extending to within 1 mm of liver capsule (Fig. 3). The normal liver tissues in both lobes were difficult to evaluate.

All abdominal ultrasound examinations were performed with standard planes using model L700 (GE Medical System, Yokogawa, Tokyo, Japan) and L9 (GE Medical Systems, Milwaukee, WI, USA) with 3.5 MHz transducer. CT of abdomen was performed using Somaton plus 4 and 16-MDCT equipment (Siemens, Erlangen, Germany) with contiguous 5-mm sections before and after i.v. administration of 100 cc nonionic contrast medium (Iopamidol, Bracco or Ultravist, Schering, Berlin, Germany).

RESULTS

Seven patients (two male and five female) with both sonograms and CT studies performed within 4 h were collected in this study. The mean age of patients was 75 y (range, 65 to 89). The main complaints and reasons for requesting sonographic examinations, causes of HPVG and prognosis of patients were listed in Table 1. Of the seven patients, dot-like pattern was found in two patients, streak-like in three and fruit-pulp-like in two. CT scans could not detect HPVG in the two patients with dot-like patterns. In the other five patients, CT scans showed a lesser amount of gas distribution in liver parenchyma compared with that of sonograms performed few hours earlier. As for the clinical prognosis, except in patient 3 with localized liver abscess, patients with streak-like or fruit-pulp-like patterns of HPVG died eventually during hospitalization. The cause of mortality was attributed to complications of ischemic bowel in all four patients. The two patients with dot-like pattern of HPVG had negative findings on the subsequent abdominal CT images and discharged uneventfully. The follow-up sonography at 2 to 4 wk after their discharges did not reveal any echogenic shadowing in the portal vein.

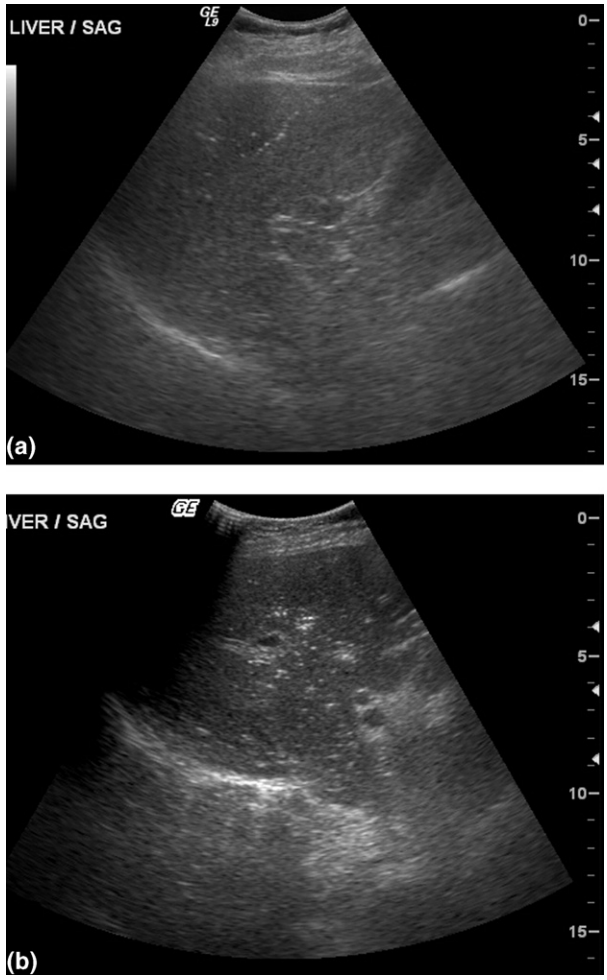

Fig. 1. Dot-like pattern of HPVG. Transient portal venous gas with echogenic spot particles presenting with branched distribution was seen at both lobes of liver in patient 1 (a) and patient 2 (b). Most liver parenchyma was still observed. The subsequent CT (not shown) showed negative abdominal findings without evidence of air in liver. They were both discharged eventfully. Patient 2 died of the complications of Dengue fever 6 months later, not related to this HPVG phenomenon.

DISCUSSION

Wolf and Evans (1955) first described HPVG in infants with necrotizing enterocolitis and described in adults by Susman and Senturia (1960). The most common and serious cause of HPVG in adults is mesenteric