

# Intrahepatic Gas Caused by Acute Gastroenteritis: Hepatic Portal Venous Gas or Biliary Tract Gas?

Chunhua Wang<sup>1</sup>, Haifeng Jin<sup>1</sup>, Hua Xue<sup>1</sup>, Yanwei Zhang<sup>2</sup>

<sup>1</sup>Department of Gastroenterology, Bethune International Peace Hospital, Shijiazhuang, Hebei, People's Republic of China; <sup>2</sup>Department of Diagnostic Radiology, Bethune International Peace Hospital, Shijiazhuang, Hebei, People's Republic of China

Correspondence: Chunhua Wang; Haifeng Jin, Department of Gastroenterology, Bethune International Peace Hospital, No. 398 Zhongshan West Street, Qiaoxi District, Shijiazhuang, Hebei, People's Republic of China, Email crown99@126.com; jinhhfjin@163.com

**Purpose:** Hepatic portal venous gas is not a specific disease and is often only an imaging manifestation in patients with acute abdomen. However, its appearance often indicates serious disease and poor prognosis. It is not difficult to distinguish typical portal venous gas from biliary tract gas on computed tomography because of their relatively different distribution within the liver. But the difference is not absolute.

**Case Description:** An 82-year-old female was admitted to the emergency department due to epigastric pain, nausea and vomiting for 1 day. Intrahepatic gas was found on computed tomography (CT), which was initially diagnosed as portal venous gas, and contrast-enhanced abdominal CT was performed 3 hours after the first plain CT scan and revealed a significant reduction of intrahepatic gas, then diagnosed as biliary tract gas. Two days later, enhanced abdominal CT showed that biliary tract gas had disappeared. Continuous gastrointestinal decompression, anti-infection, rehydration and other treatments were given. After treatment, abdominal pain, nausea, vomiting and other symptoms of the patient were gradually relieved. The patient refused gastroenteroscopy and was discharged after 13 days of hospitalization.

**Conclusion:** Portal venous gas and biliary tract gas may have similar CT findings and be misdiagnosed, and enhanced CT examination is necessary to confirm the diagnosis.

**Keywords:** hepatic portal venous gas, biliary tract gas, acute gastroenteritis, computed tomography, case report

## Introduction

Hepatic portal venous gas (HPVG) is an imaging sign formed by abnormal aggregation of gas in the portal vein and its intrahepatic portal vein branches due to various reasons, which is relatively rare in clinic and often accompanied by acute abdomen such as intestinal ischemia, intestinal necrosis. Since Wolfe et al first reported this disease in 1955,<sup>1</sup> with the development of color ultrasound, computed tomography (CT) and other imaging technologies, more and more HPVG has been found. Due to its specificity in pathogenesis, etiology, diagnosis, treatment and other aspects, it has also attracted more and more clinical attention.

Biliary tract gas is relatively common in clinic work. There are many reasons for biliary tract gas, including a variety of operations related to the biliary tract and lesions affecting the biliary tract, such as chronic cholecystitis or cholelithiasis, cholangitis; Oddi's sphincter insufficiency; chronic gastrointestinal ulcer disease, ulcer to the biliary perforation of internal fistula; biliary-bronchial fistula and so on.<sup>2</sup>

Unlike HPVG, which is mainly distributed at the outer edge of the liver and involved many small vessels, biliary tract gas is mainly distributed at the biliary tract site in the middle of the liver, with mostly dispersed and discontinuous gas shadows, which do not extend to the edge of the liver. It is relatively easy to distinguish HPVG from biliary tract gas due to the difference of distribution sites.<sup>3</sup> Here, however, we present a rare case of intrahepatic biliary tract gas caused by acute gastroenteritis, CT showed multiple dendritic gas shadows at the liver edge, which was consistent with the performance of HPVG, and finally diagnosed as biliary tract gas.

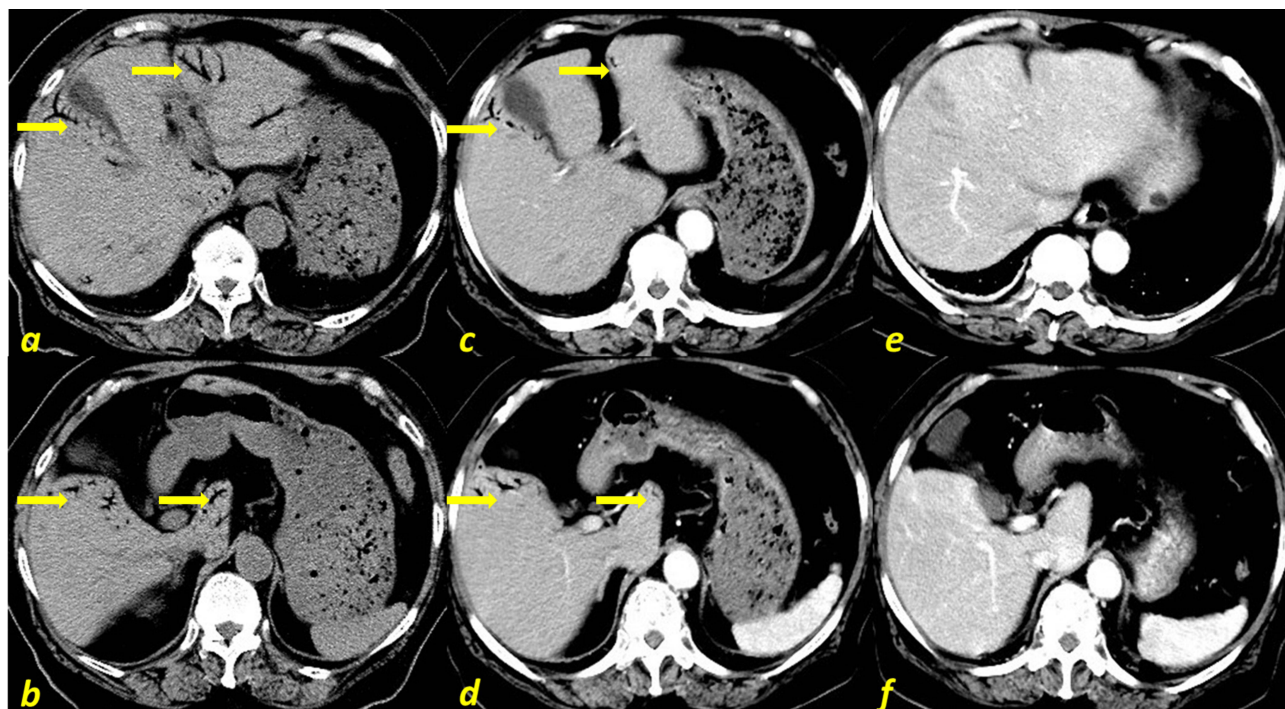
## Case Report

An 82-year-old female was admitted to the emergency department due to epigastric pain, nausea and vomiting for 1 day. Abdominal computed tomography (CT) was performed at a local hospital indicating HPVG (Figure 1a and b; the yellow arrow points to the gas shadow) and for this reason the patient was referred to our hospital for treatment on the day of onset. On the day of admission, her temperature was 38.2°C, respiratory rate was 18 breaths per minute and oxygen saturation was 98% on air, the pulse was 88 beats per minute, lying blood pressure was 122/84 mmHg. The only abnormal physical examination was epigastric tenderness. Laboratory studies showed a white blood cell of  $18.81 \times 10^9/L$ ; neutrophils, 89.2%; hemoglobin (HB), 122g/L; blood platelet count  $275 \times 10^9/L$ , hypersensitive C-reactive protein 87.82mg/L. The arterial blood gas analysis, serum creatinine, blood urea nitrogen, serum amylase, total bilirubin and hepatic enzyme spectrum were normal. Continuous gastrointestinal decompression, anti-infection, rehydration and other treatments were given. Contrast-enhanced abdominal CT was performed 3 hours after the first plain CT scan and revealed a significant reduction of intrahepatic biliary tract gas (Figure 1c and d). Two days later, enhanced abdominal CT showed that intrahepatic biliary tract gas had disappeared (Figure 1e and f). After treatment, abdominal pain, nausea, vomiting and other symptoms gradually relieved. Antibiotics were discontinued after 7 days, and blood cultures were not performed. The patient refused gastroenteroscopy and was discharged after 13 days of hospitalization. After six months of follow-up, the patient recovered well without abdominal pain, fever, vomiting and other symptoms.

## Discussion

HPVG is not a specific disease and is often just an imaging manifestation in patients with acute abdomen. However, its appearance often indicates serious disease and poor prognosis. However, with the improvement of imaging technology, more and more cases are being diagnosed due to various benign lesions.<sup>4,5</sup>

There are two ways for gas to enter the portal vein: first, the pressure in the dilated intestinal canal increases, and the edema, necrosis and destruction of the mucosal barrier of the intestinal mucosa make the gas in the intestinal lumen penetrate into the small veins in the intestinal wall and return to the portal vein through the mesenteric vessels; Another



**Figure 1** (a and b) The first CT scan indicated that the gas was located at the liver edge (yellow arrow) more like HPVG. (c and d) Contrast-enhanced abdominal CT showed a significant reduction of gas. Compared with the yellow arrows in (a and b) the gas shadows in (c and d) are significantly reduced. (e and f) In contrast to the yellow arrows in (a and b), contrast-enhanced abdominal CT showed disappearance of intrahepatic biliary tract gas.

way is the infection of intestinal and peritoneal aerogenic bacteria affecting intestinal mucosa or small veins, direct infection of intravenous aerogenic bacteria causes gas accumulation in portal vein. As the portal vein blood flow is away from the direction of the hepatic portal, the blood flow can bring gas to the small veins, and the portal vein can be seen under the capsule at the edge of the liver. Enhanced CT clearly shows gas in the portal vein.<sup>6</sup> For this patient, the first abdominal CT showed more air accumulation in the intrahepatic margin, and the gastric contents increased significantly, which was considered as increased pressure of digestive tract, gastrointestinal mucosal damage, intestinal gas entering into intestinal mucosal vein along the pressure gradient, and back into portal vein to cause HPVG.

But 3 hours later, another enhanced CT showed significantly reduced intrahepatic gas accumulation, and portal vein stage suggested that no gas was found in portal vein, which was considered as biliary tract gas.

Clinically, biliary tract gas is mostly located in the bold tube in the central part of the liver, mainly in the left and right hepatic ducts, mostly scattered and discontinuous gas shadow, which does not extend to the edge of the liver (biliary tract gas is mostly located in the central part of the liver due to the centripetal flow of bile). CT examination can better display intrahepatic biliary tract gas, and biliary tract gas is generally found in the left lobe of the liver. Enhanced CT scan can distinguish the portal vein and its accompanying bile duct, so as to distinguish the portal vein gas from the biliary tract gas.<sup>7</sup>

As for the cause of biliary tract gas in this case, considering the patient's old age, no history of biliary surgery, and no other lesions indicated by CT, it should be the result of Oddi's sphincter dysfunction. The patient developed nausea and vomiting, resulting in excessive gastrointestinal pressure and gas backflow into the biliary tract.

The distribution of biliary tract gas in the liver was abnormal in this case and was initially diagnosed as HPVG. There are little clinical data on abnormal distribution of biliary tract gas, and theoretical research and support are also lacking. Oddi's sphincter can withstand pressures of up to 60cmH<sub>2</sub>O, which normally prevents retrograde airflow in the common bile duct.<sup>8</sup> We deduce the possible reasons for the special imaging appearance of biliary tract gas as follows: Increased in patients with gastrointestinal tract pressure (>60cmH<sub>2</sub>O), causing the gas transiently back into the relatively loose Oddi's sphincter, since the gastrointestinal and abdominal pressure was higher than that of the biliary tract, the gas in the biliary tract gradually entered the small biliary tract due to pressure and appeared at the edge of the liver. With gastrointestinal decompression, gastrointestinal pressure is reduced, bile flow is accelerated, and biliary gas is gradually discharged into the common bile duct and into the intestinal cavity. This may explain why there was a significant decrease in biliary tract gas at CT reexamination 3 hours later.

## Conclusion

HPVG is rare in clinic and biliary tract gas misdiagnosed as HPVG has never been reported. We present this case to increase our understanding of the differential diagnosis of bile duct and portal venous gas by imaging. It is not accurate to confirm portal venous gas by plain CT scan. The distribution of biliary tract gas near hepatic margin requires further observation and verification.

## Abbreviations

HPVG, hepatic portal venous gas; CT, computed tomography.

## Ethical Approval and Consent for Publication

Institutional Review board (IRB) approval for this study was not required. The patient gave her consent for the publication of information related to her medical condition.

## Funding

There is no funding to report.

## Disclosure

The authors declare they have no competing interest for this study.

## References

1. Wolfe JN, Evans WA. Gas in the portal veins of the liver in infants; a roentgenographic demonstration with postmortem anatomical correlation. *Am J Roentgenol Radium Ther Nucl Med.* 1955;74(3):486–488.
2. Sherman SC, Tran H. Biliary tract gas: benign or life-threatening. *J Emerg Med.* 2006;30(2):147–153. doi:10.1016/j.jemermed.2005.05.016
3. Abboud B, El Hachem J, Yazbeck T, Doumit C. Hepatic portal venous gas: physiopathology, etiology, prognosis and treatment. *World J Gastroenterol.* 2009;15(29):3585–3590. doi:10.3748/wjg.15.3585
4. Solakoglu T, Sari SO, Koseoglu H, et al. A case of Hepatic portal venous gas after colonoscopy. *Arab J Gastroenterol.* 2016;17(3):140–142. doi:10.1016/j.ajg.2016.08.004
5. Zuwasti U, Shashidhar A, Haas C. A rare case of transient portal venous gas. *Radiol Case Rep.* 2020;15(11):2053–2055. doi:10.1016/j.radcr.2020.08.035
6. Liebman PR, Patten MT, Manny J, Benfield JR, Hechtman HB. Hepatic–portal venous gas in adults: etiology, pathophysiology and clinical significance. *Ann Surg.* 1978;187(3):281–287. doi:10.1097/00000658-197803000-00012
7. Yarze JC, Markowitz DM. Distinguishing between hepatic portal vein gas and pneumo(aero)bilia. *Liver Transplant.* 2007;13(10):1476; author reply 1477. doi:10.1002/lt.21239
8. Fourneau H, Grandjean C. Biliary tract gas caused by blunt abdominal trauma. *J Belgian Soc Radiol.* 2019;103(1):1. doi:10.5334/jbsr.1661

International Medical Case Reports Journal

Dovepress

### Publish your work in this journal

The International Medical Case Reports Journal is an international, peer-reviewed open-access journal publishing original case reports from all medical specialties. Previously unpublished medical posters are also accepted relating to any area of clinical or preclinical science. Submissions should not normally exceed 2,000 words or 4 published pages including figures, diagrams and references. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/international-medical-case-reports-journal-journal>