



Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Extensive portal venous gas: Unlikely etiology and outcome

Tiffany P. Schatz^{a,*}, Mohammed O. Nassif^{b,c}, Jeffrey M. Farma^b^a Department of Surgery, Waterbury Hospital, 64 Robbins Street, Waterbury, CT 06708, USA^b Department of Surgical Oncology, Fox Chase Cancer Center, 333 Cottman Avenue, Philadelphia, PA 19111, USA^c Department of Surgery, King Abdulaziz University, P.O. Box 80205, 21589 Jeddah, Saudi Arabia

ARTICLE INFO

Article history:

Received 13 September 2014

Accepted 14 October 2014

Available online 11 December 2014

Keywords:

Hepatic portal venous air

Portal gas

Pneumatosis intestinalis

Acute abdomen

ABSTRACT

Portal venous gas or hepatic portal venous gas (HPVG) found on imaging portends grave outcomes for patients suffering from ischemic bowel disease or mesenteric ischemia. HPVG is more rarely seen with severe but treatable abdominal infection as well as multiple benign conditions, and therefore must be aggressively evaluated. We report a 70-year old female who developed extensive intra- and extra-hepatic portal venous gas, pneumatosis intestinalis and free air associated with a perforation of the jejunojejunostomy after a gastrectomy for gastric carcinoma.

© 2015 The Authors. Published by Elsevier Ltd. on behalf of Surgical Associates Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

HPVG was first described in infants with necrotizing enterocolitis (NEC) by Wolfe and Evans in 1955,¹ and was then reported in increasing frequency in adults as well.² HPVG has been most commonly associated with an acute gastrointestinal catastrophe, such as mesenteric ischemia, with up to 80% of cases resulting in death.³ Cases in which HPVG is found with mesenteric ischemia often present with abdominal distention, pain, fever, and possibly sepsis, however the extent of the portal venous gas or pneumatosis intestinalis, gas seen on imaging in the small or large intestine, is not predictive of the extent of the disease itself, or of the operative findings.⁴ Initially noted in abdominal x-ray films as branching radiolucency within 2 cm of the hepatic edge, other modalities such as ultrasound, Doppler imaging, and computed tomography (CT) detect HPVG with far more sensitivity.^{5,6} With increased use of advanced diagnostic imaging, HPVG has also been an incidental finding in many benign diseases, and therefore cannot on its own be used as a prognostic indicator.⁷

2. Presentation of Case

A 70-year old female patient underwent an elective gastrectomy and feeding jejunostomy for stage IIA gastric cancer, after biopsies of a 3 cm gastric ulcer showed moderately differentiated

adenocarcinoma. The patient had initially presented with a pulmonary embolism, Factor V Leiden and subsequently developed an upper gastrointestinal hemorrhage for which she had an upper endoscopy revealing a uT3N0 gastric tumor (Fig. 1). She underwent neoadjuvant chemotherapy with epirubicin, oxaliplatin, and fluorouracil (EOF).

The initial procedure consisted of total gastrectomy with D2 lymph node dissection, Roux-en-Y esophagojejunostomy and placement of a feeding jejunostomy. The patient developed ARDS postoperatively and was treated with high dose steroids.

On post-operative day 14, the patient became hypotensive with new acute abdominal pain and peritonitis. CT scan showed extensive intra- and extra-hepatic portal venous gas, with an air-fluid level in the main portal vein, as well as small bowel pneumatosis, with free intraperitoneal air (Figs. 1 and 2). She was taken back to the operating room emergently for exploration.

Intraoperatively, two small perforations were found at the distal jejunojejunostomy with no ischemia or necrosis of any of the bowel was found. Red rubber catheters were placed in the two defects in the edematous anastomosis, proximally and distally along with intra-abdominal drains. She underwent a second look procedure after 48 h, and the abdomen was closed.

Post-operatively the patient was stabilized and was eventually discharged in stable condition to a rehabilitation facility. Now, ten months from her original procedure, the patient is living at home with a performance status of 1 and is currently on chemotherapy as she unfortunately developed a liver metastasis.

3. Discussion

Hepatic portal venous gas with the finding of pneumatosis intestinalis is most frequently associated with ischemic bowel, with

Abbreviations: HPVG, hepatic portal venous gas; NEC, necrotizing enterocolitis; CT, computed tomography; EOF, epirubicin, oxaliplatin, and fluorouracil; IBD, inflammatory bowel disease; COPD, chronic obstructive pulmonary disease; PUD, peptic ulcer disease; SBO, small bowel obstruction; LDH, lactate dehydrogenase.

* Corresponding author. Tel.: +1 215 901 3912.

E-mail address: tiffanyschatz@gmail.com (T.P. Schatz).

<http://dx.doi.org/10.1016/j.ijscr.2014.10.058>

2210-2612/© 2015 The Authors. Published by Elsevier Ltd. on behalf of Surgical Associates Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

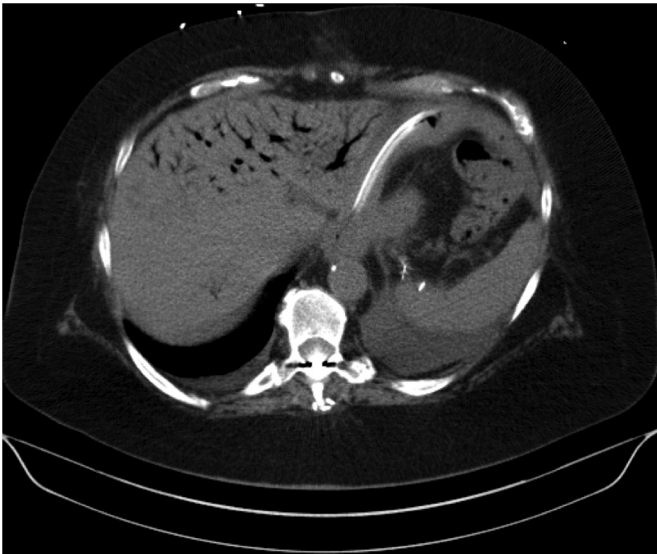


Fig. 1. Axial view of abdominal/pelvic CT scan showing extensive hepatic portal venous gas and pneumatosis intestinalis.

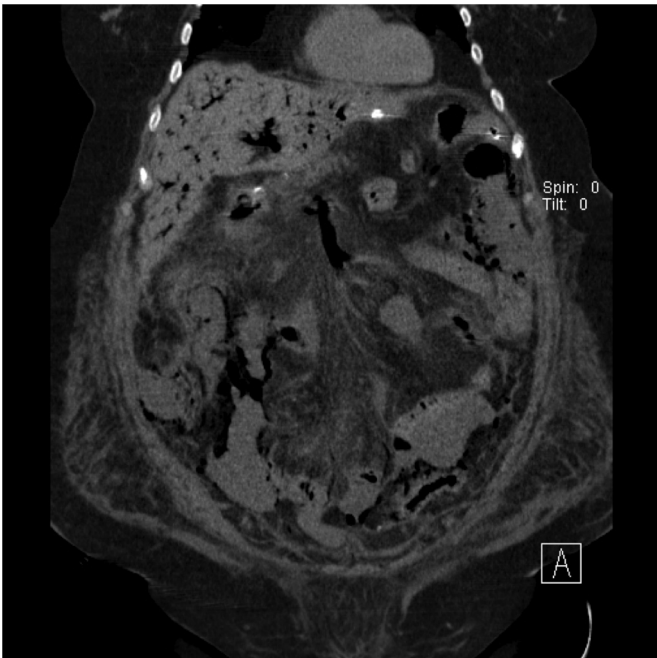


Fig. 2. Coronal view of abdominal/pelvic CT scan showing extensive gas in the superior mesenteric vein.

a reported mortality of 39–80% and up to 100% without operative intervention.^{3,5,8–10} First described in 1955 associated in infants with necrotizing enterocolitis,¹ HPVG has since been described in numerous other clinical scenarios. Some less morbid causes of portal venous gas include ileus,¹¹ diverticulitis,^{12,13} gastric distention,^{14,15} inflammatory bowel disease (IBD),¹⁶ hypotension post dialysis treatment,¹⁷ decompression sickness,¹⁸ trauma¹⁹ and iatrogenic causes from instrumentation and recent surgery either with or without complications related the procedure.^{8,20} Some benign causes of pneumatosis intestinalis, but not directly shown to cause HPVG, include high-pressure ventilation, chronic obstructive pulmonary disorder (COPD), and high dose steroids as well as numerous other conditions both organic and iatrogenic.²¹ The

clinical presentation in these cases is dependent on the etiology of the disease.^{8,22}

Clinical scenarios leading to HPVG generally fall into three categories: bowel distention/obstruction, ischemia, and idiopathic.⁸ These mechanisms are coupled with the two main theories proposed for the pathophysiologic etiology of HPVG: mechanical versus bacterial. First, mechanical disruption of mucosal integrity may result in dissection of gas into the intestinal wall and eventually the portal system. The breach of integrity of mucosa may be related to ulceration from ischemia, IBD, peptic ulcer disease (PUD), or from gastrointestinal neoplasms. Alternatively, the invasion or translocation of the intestinal wall by gas forming bacteria may result in the production of gas within the intestinal wall and portal system itself.^{8,23} Likely both mechanisms play a role in the development and propagation of HPVG.²⁴

Assessment of the varied presentation of patients with HPVG has led to the suggestion of new algorithms in recent years to better identify patients who would benefit from operative intervention, versus those who may not. Despite the a small population sizes used for these studies, all placed similar in emphasis on the clinical status of the patient, rather than the CT findings alone, including physical exam findings, vital signs, and laboratory values.^{8,23,25,26}

These algorithms will ideally help distinguish between patients with potentially benign disease, versus patients with necrotic bowel who may benefit from emergent surgery. Based on findings from a retrospective review of 26 patients from their institution, Iannitti et al.²⁷ suggest that surgery should be recommended with certain presentations (frank peritonitis), additional CT findings (complete small bowel obstruction—SBO, mesenteric ischemia), certain recent interventions (e.g. vascular surgery procedures), or with complicated medical diagnosis (complicated infectious or inflammatory process). Koami, et al., found that in their sample of 33 patients with HPVG, using a criteria of lower blood pressure (<systolic BP 108 mm Hg), higher lactate dehydrogenase (LDH) (>387 U/L), and the presence of pneumatosis intestinalis led to 100% sensitivity and 78.9% specificity for necrotic bowel.²⁶ Another retrospective review of 150 patients by Duron et al.²⁸ showed that abdominal distention (or CT finding of small bowel distention), peritonitis, and lactic acidemia were the only statistically significant predictors of positive operative findings. In one of the largest retrospective reviews, Bani Hani et al.²⁹ pooled data from four tertiary centers and evaluated 209 patient charts who had HPVG in order to better predict which patients require operative intervention. After assessing a range clinical findings, laboratory values, radiologic findings and comorbidities, they found that older age, peritoneal signs, and elevated BUN are most highly associated with ischemia and necrotic bowel.

One of the most detailed algorithms developed by Wayne et al. used a retrospective series of 88 patients. The algorithm incorporates many of the previously mentioned clinical findings, including abdominal exam, lactate (>3 mg/dL), and radiological findings of pneumatosis intestinalis, as well as, recent instrumentation, and significant past medical history suggestive of vascular risk. Using these factors, the group tested the algorithm prospectively on 14 patients, ideally reducing the risk of nontherapeutic laparotomies, but with four patients not explored described as ‘futile’. The decision-making process for futility was not discussed.⁸

4. Conclusion

Our patient had a variety of the potential causes of HPVG, including recent surgery, intestinal distention, ischemia related to hypotension and inotropes. The complicated postoperative course, along with the clinical picture and the finding of extensive HPVG and pneumatosis intestinalis led to frank discussions with the

family regarding the grave nature of this finding and the high risk of surgical intervention. Nonetheless, the operative findings and outcome of this case illustrate the inability to predict the extent of bowel compromise based on HPVG, suggesting that an aggressive surgical approach is still appropriate, even when the prognosis and radiographic findings appears dismal.

Ethical statement

Written informed consent was obtained from the patient for publication of this Case report and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

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):486–8.
2. 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):281–7.
3. Peloponissios N, Halkic N, Pugnale M, Jornod P, Nordback P, Meyer A, et al. Hepatic portal gas in adults: review of the literature and presentation of a consecutive series of 11 cases. *Arch Surg* 2003;**138**(12):1367–70.
4. Chien-Hua L, Jyh-Cherng Y, Huan-Fa H, Hurng-Sheng W, Shih-Yi C, Chu-Hsin C. Pneumatosis intestinalis and hepatic–portal–mesenteric venous gas in intestinal ischemia. *Rev Esp Enferm Dig* 2007;**99**(2):96–9.
5. Monneuse O, Pilleul F, Barth X, Gruner L, Allaouchiche B, Valette PJ, et al. Portal venous gas detected on computed tomography in emergency situations: surgery is still necessary. *World J Surg* 2007;**31**(5):1065–71.
6. Pan HB, Huang JS, Yang TL, Liang HL. Hepatic portal venous gas in ultrasonogram – benign or noxious. *Ultrasound Med Biol* 2007;**33**(8):1179–83.
7. Abboud B, El Hachem J, Yazbeck T, Doumit C. Hepatic portal venous gas: physiopathology, etiology, prognosis and treatment. *World J Gastroenterol* 2009;**15**(29):3585–90.
8. Wayne E, Ough M, Wu A, Liao J, Andresen KJ, Kuehn D, et al. Management algorithm for pneumatosis intestinalis and portal venous gas: treatment and outcome of 88 consecutive cases. *J Gastrointest Surg* 2010;**14**(3):437–48.
9. Wiesner W, Morteale KJ, Glickman JN, Ji H, Ros PR. Pneumatosis intestinalis and portomesenteric venous gas in intestinal ischemia: correlation of CT findings with severity of ischemia and clinical outcome. *AJR Am J Roentgenol* 2001;**177**(6):1319–23.
10. Kinoshita H, Shinozaki M, Tanimura H, Umemoto Y, Sakaguchi S, Takifuji K, et al. Clinical features and management of hepatic portal venous gas: four case reports and cumulative review of the literature. *Arch Surg* 2001;**136**(12):1410–4.
11. Quirke TE. Hepatic–portal venous gas associated with ileus. *Am Surg* 1995;**61**(12):1084–6.
12. Sen M, Akpınar A, Inan A, Sisman M, Dener C, Akin K. Extensive hepatic–portal and mesenteric venous gas due to sigmoid diverticulitis. *World J Gastroenterol* 2009;**15**(7):879–81.
13. Zielke A, Hasse C, Nies C, Rothmund M. Hepatic–portal venous gas in acute colonic diverticulitis. *Surg Endosc* 1998;**12**(3):278–80.
14. Bani-Hani KE, Heis HA. Iatrogenic gastric dilatation: a rare and transient cause of hepatic–portal venous gas. *Yonsei Med J* 2008;**49**(4):669–71.
15. Al-Jundi W, Shebl A. Emphysematous gastritis: case report and literature review. *Int J Surg* 2008;**6**(6):e63–6.
16. Ng SS, Yiu RY, Lee JF, Li JC, Leung KL. Portal venous gas and thrombosis in a Chinese patient with fulminant Crohn's colitis: a case report with literature review. *World J Gastroenterol* 2006;**12**(34):5582–6.
17. Suzuki K, Umaoka A, Katayama N, Imai H. Transient extensive hepatic portal venous gas following hypotension in a dialysis patient. *BMJ Case Rep* 2013:2013.
18. Morita S, Yamagiwa T, Inokuchi S. Portal venous gas on computed tomography imaging in patients with decompression sickness. *J Emerg Med* 2013;**45**(1):e7–11.
19. Sen I, Samarasingh I, Chandran S, Mathew G. Gastric intramural and portal venous gas following blunt abdominal injury. *Arch Trauma Res* 2013;**2**(2):95–6.
20. Mogno P, Chosidow D, Marmuse JP. Hepatic portal gas due to gastro–jejunal anastomotic leak after laparoscopic gastric bypass. *Obes Surg* 2005;**15**(2):278–81.
21. Khalil PN, Huber-Wagner S, Ladurner R, Kleespies A, Siebeck M, Mutschler W, et al. Natural history, clinical pattern, and surgical considerations of pneumatosis intestinalis. *Eur J Med Res* 2009;**14**(6):231–9.
22. Lee HS, Cho YW, Kim KJ, Lee JS, Lee SS, Yang SK. A simple score for predicting mortality in patients with pneumatosis intestinalis. *Eur J Radiol* 2014;**83**(4):639–45.
23. Nelson AL, Millington TM, Sahani D, Chung RT, Bauer C, Hertl M, et al. Hepatic portal venous gas: the ABCs of management. *Arch Surg* 2009;**144**(6):575–81, discussion 81.
24. Sebastia C, Quiroga S, Espin E, Boye R, Alvarez-Castells A, Armengol M. Portomesenteric vein gas: pathologic mechanisms, CT findings, and prognosis. *Radiographics* 2000;**20**(5):1213–24, discussion 24–6.
25. Villa M, Ranade AN, Jaimes-Vanegas N, Walden H, D'Agostino CA, Nicastro J, et al. "STOP, LOOK, and LISTEN." Hepatic portal venous gas: time for clinical assessment! *Int J Angiol* 2013;**22**(2):123–6.
26. Koami H, Isa T, Ishimine T, Kameyama S, Matsumura T, Yamada KC, et al. Risk factors for bowel necrosis in patients with hepatic portal venous gas. *Surg Today* 2015;**45**(2):156–61 (ISSN: 1436–2813).
27. Iannitti DA, Gregg SC, Mayo-Smith WW, Tomolonis RJ, Cioffi WG, Pricolo VE. Portal venous gas detected by computed tomography: is surgery imperative? *Dig Surg* 2003;**20**(4):306–15.
28. Duron VP, Rutigliano S, Machan JT, Dupuy DE, Mazzaglia PJ. Computed tomographic diagnosis of pneumatosis intestinalis: clinical measures predictive of the need for surgical intervention. *Arch Surg* 2011;**146**(5):506–10.
29. Bani Hani M, Kamangar F, Goldberg S, Greenspon J, Shah P, Volpe C, et al. Pneumatosis and portal venous gas: do CT findings reassure? *J Surg Res* 2013;**185**(2):581–6.

Open Access

This article is published Open Access at sciedirect.com. It is distributed under the [IJSCR Supplemental terms and conditions](#), which permits unrestricted non commercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.