

# DIFFERENTIAL DIAGNOSIS AND CLINICAL RELEVANCE OF PNEUMOBILIA OR PORTAL VEIN GAS ON ABDOMINAL X-RAY

Zoran Rajković<sup>1</sup>, Dino Papeš<sup>1</sup>, Silvio Altarac<sup>1</sup> and Nuhi Arslani<sup>2</sup>

<sup>1</sup>Department of Surgery, Zabok General Hospital, Zabok, Croatia; <sup>2</sup>Department of Surgery, Maribor University Clinical Center, Maribor, Slovenia

**SUMMARY** – The purpose of the article is to present the differential diagnostic criteria between pneumobilia (air in the biliary system) and portal vein gas on abdominal x-ray. Differential diagnosis is essential because of its influence on patient management. Two patients are presented, one with pneumobilia and the other with portal vein gas on abdominal x-ray, with review of the relevant literature. Pneumobilia is often iatrogenic and even in cases of cholecystitis it is never a sole indication for emergency surgery. Patients with pneumobilia on abdominal x-ray can always be investigated further. On the other hand, the presence of air in portal vein is in most cases a sign of acute mesenteric ischemia. In adults with abdominal pain indicating intestinal ischemia (pain that is 'out of proportion' to clinical abdominal examination findings), it is an indication for emergency exploratory laparotomy. It is vital to act early when intestinal ischemia is suspected.

**Key words:** *Pneumobilia; Portal vein – radiography; Portal vein – pathology; Embolism, air – radiography; Intestinal ischemia; Radiography, abdominal*

## Introduction

Pneumobilia and portal vein gas can be similar on abdominal x-ray but differential diagnosis is very important because of its influence on patient management.

We present two patients: one that was found to have pneumobilia due to bilioenteric fistula, and another one that had portal vein gas associated with massive embolism of celiac axis and superior mesenteric artery.

## Case 1

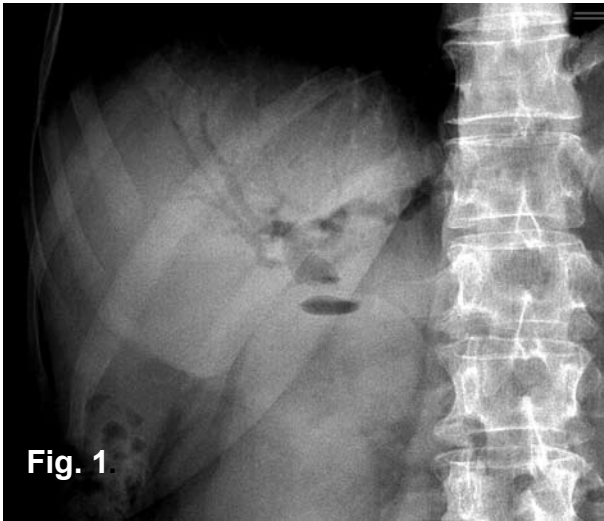
A 65-year-old female patient presented with diffuse abdominal tenderness, vomiting, and fever up to 39 °C, which lasted for three days. She had vomited

up to five times a day. Her last stool was 5 days before. On physical examination, she was dehydrated and the abdomen was soft, distended and diffusely tender, without guarding. The rest of her history was unremarkable. Besides occasional analgesics, she did not take any medication. Laboratory tests showed white blood cell count (WBC) 14000/mL and C-reactive protein (CRP) 25; basic metabolic panel, red blood cell count (RBC), hemoglobin, hematocrit, amylase and lipase were within the normal range. Plain abdominal x-ray showed pneumobilia (Fig. 1). Upper gastrointestinal (GI) series showed communication between the duodenum and the gallbladder that was filled with air, and contrast marking the biliary tree (Fig. 2). Computed tomography (CT) scan showed a bilioenteric fistula between the gallbladder and the duodenum, and identified the gallstone, 6.5 cm in diameter in the jejunum (Fig. 3).

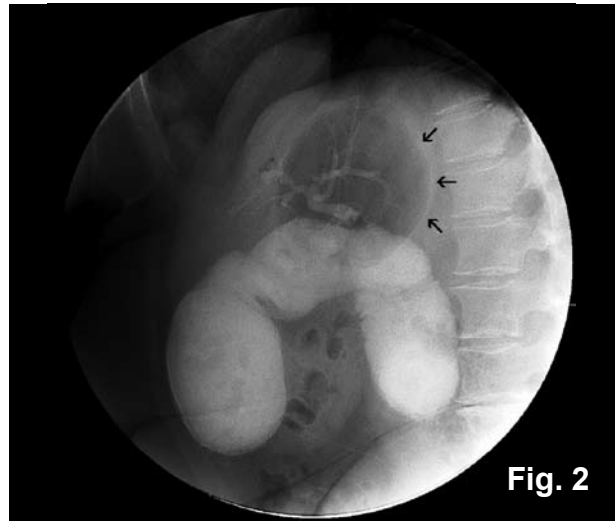
On the next day, cholecystectomy, extraction of gallstone and closure of the bilioenteric fistula were

Correspondence to: *Dino Papeš, MD*, Department of Surgery, Zabok General Hospital, Bračak 8, HR-49210 Zabok, Croatia  
E-mail: dinopapes@gmail.com

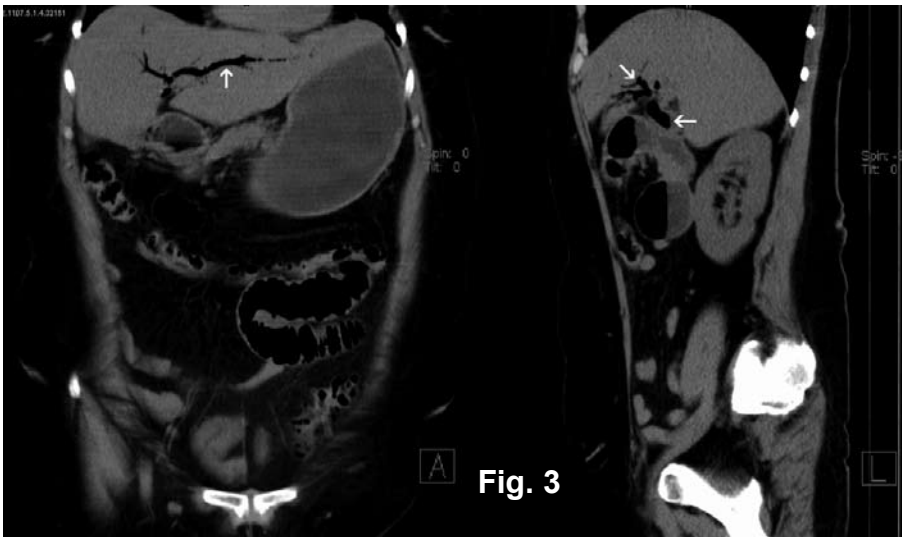
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**Fig. 1**



**Fig. 2**



**Fig. 3**



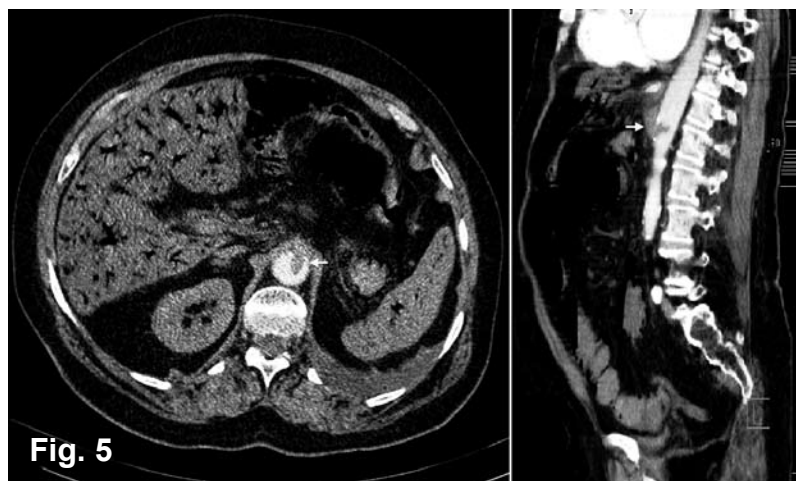
**Fig. 4**

*Fig. 1. Abdominal x-ray with magnified upper right quadrant shows pneumobilia. Air is located in the hilum within several branches, a typical finding in pneumobilia.*

*Fig. 2. Upper GI series shows the gallbladder filled with air (arrows) and contrast in the biliary tree.*

*Fig. 3. Abdominal CT scan shows pneumobilia (arrows).*

*Fig. 4. Abdominal x-ray with magnified upper right quadrant shows air in the portal vein. There are many branches giving a tree-like appearance, with air reaching almost to the liver margin, well beyond the imaginary area 2 cm from the liver margin.*



*Fig. 5. Abdominal CT angiography shows portal vein gas and the embolus (arrows) in the origin of the celiac axis, which is the cause of massive intestinal ischemia.*

performed. On laparotomy, a longitudinal enterotomy was made along the antimesenteric border proximal to the point of impaction. The stone was milked proximally and removed. This is because the impacted stone can cause pressure ischemia of the bowel wall at the site of impaction, so a suture line at that site can become compromised and lead to dehiscence. Enterotomy was closed transversely to avoid bowel stenosis. The patient recovered completely.

## Case 2

A 70-year-old female patient presented with rapid onset of diffuse abdominal pain and fever that lasted for 8 hours. She suffered from atrial fibrillation and had been hospitalized for workup several years before, and was prescribed amiodarone 200 mg once a day and acetylsalicylic acid 100 mg once a day. She also had cholelithiasis without symptoms, which was detected on routine abdominal ultrasound. The rest of her history was unremarkable. On physical examination, she was in mild distress and her abdomen was slightly distended, painful in the epigastrium, with no abdominal guarding. Laboratory tests showed WBC 16000/mL, CRP 15, normal RBC, hemoglobin and hematocrit, blood urea nitrogen 12 mmol/L, creatinine 285 mmol/L, sodium 136 mmol/L and potassium 6.1 mmol/L. Liver enzymes were also elevated: aspartate transaminase 180, alanine aminotransferase 205 and gamma-glutamyltransferase 361. Standard electrocardiogram showed atrial fibrillation. Abdominal x-ray showed air in the portal vein (Fig. 4). A

CT scan showed air in the portal vein system, and in the lumen of the stomach and small intestine. Massive embolism of both celiac trunk and superior mesenteric artery was seen after contrast administration (Fig. 5). Emergency exploratory laparotomy was subsequently performed, and necrosis of the liver, spleen, stomach and small intestine was found. The patient died of multiple organ failure only several hours after the surgery.

## Discussion

Pneumobilia, or air within the biliary tree of the liver, suggests an abnormal communication between the biliary tract and the intestines, or infection by gas-forming bacteria. Common causes include biliary surgery, biliary sphincterotomy, biliary stenting, bilioenteric anastomosis or fistula, incompetent sphincter of Oddi, abdominal trauma and emphysematous cholecystitis<sup>1,2</sup>. Most cases are iatrogenic and in all cases of newly diagnosed pneumobilia, further evaluation should be undertaken. Pneumobilia is never an indication for emergency exploratory laparotomy.

On the other hand, gas in the portal venous system is an ominous sign. It is mostly caused by intestinal ischemia and necrosis (in over 75% of cases), and other possible causes include bowel tumor necrosis, ulcerative colitis, diverticulitis, pelvic abscess, pancreatitis and necrotizing enterocolitis, but it can also be iatrogenic (e.g., from liver biopsy, enema) or appear in benign conditions such as diarrhea<sup>3-6</sup>. Since the introduction of CT scan, more benign and non-surgical

conditions (e.g., graft-*versus*-host disease) have been found to be the possible causes of portal venous gas<sup>3,6</sup>. Therefore, Nelson *et al.* have developed algorithms for the management of patients with portal venous gas. If portal venous gas is found on x-ray in patients with diffuse abdominal pain, current algorithm suggests 'aggressive stand', meaning emergency exploratory laparotomy because mortality in such cases reaches 70%<sup>6</sup>. This algorithm does not apply for infants or patients who do not have abdominal complaints.

Differential diagnosis between pneumobilia and portal vein gas on abdominal x-ray can sometimes be hard. Nevertheless, there are important differences that can be seen in most cases. In pneumobilia, air is more centrally located in the hilum and branches are fewer in number (Fig. 1). The suggested cause is that bile moves from the periphery towards the hilum. On the other hand, portal vein gas is more peripheral, as it spreads with blood flow, showing more branches, and a tree-like appearance (Fig. 4). If ducts filled with air are seen within 2 cm of the liver margin, it is highly indicative of portal system gas. This was first noted in the work of Sisk<sup>7</sup>. Also, portal venous gas is in most cases transient because of the blood flow. The lack of change in the pattern of air over several hours is more consistent with pneumobilia.

In approximately 50% of reported cases, portal vein gas is found together with pneumatosis intestinalis, and patients who have portal vein gas are more likely to have transmural bowel necrosis than those with pneumatosis intestinalis alone<sup>8</sup>. Nevertheless, it has been shown that the finding of portal venous gas does not allow prediction of the magnitude of transmural bowel infarction and patient prognosis, because it can be observed in patients with only partial ischemic bowel wall damage, which can easily be resected<sup>9</sup>.

To conclude, we point out that patients with pneumobilia on abdominal x-ray can often be investigated further and there is no need for emergency surgical intervention. On the other hand, patients with portal vein gas and abdominal pain indicating intestinal ischemia (pain that is 'out of proportion' to clinical abdominal examination findings) should undergo emergency exploratory laparotomy. It is crucial to act early when intestinal ischemia is suspected, although this is sometimes not easy.

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## Sažetak

DIFERENCIJALNA DIJAGNOSTIKA I KLINIČKO ZNAČENJE PNEUMOBILIJE ILI ZRAKA  
U PORTALNOJ VENI NA RENDGENSKOJ SNIMCI ABDOMENA*Z. Rajković, D. Papeš, S. Altarac i N. Arslani*

Cilj rada je prikazati diferencijalno-dijagnostičke kriterije između pneumobilije i zraka u portalnom venskom sustavu na rendgenskoj snimci nativnog abdomena. Ti kriteriji su ključni, jer o njima ovisi daljnje postupanje s bolesnikom. Prikazane su dvije bolesnice, jedna s nalazom pneumobilije, a druga s nalazom zraka u portalnoj veni na rendgenskoj snimci nativnog abdomena, te je pretražena literatura. Pneumobilija je često jatrogena i čak u slučajevima kolecistitisa nije isključiva indikacija za hitan kirurški zahvat. Bolesnike kod kojih je nađena pneumobilija na snimci nativnog abdomena se uvijek može uputiti na daljnji dijagnostički postupak. Međutim, prisutnost zraka u portalnoj veni je u većini slučajeva znak mezenterijske ishemije. U odraslih bolesnika koji se žale na bol koja bi mogla odgovarati mezenterijskoj ishemiji (vrlo jaka bol uz mekan trbuh) zrak u portalnoj veni je indikacija za hitnu eksplorativnu laparotomiju. Od vitalne važnosti je djelovati brzo kada se sumnja na mezenterijsku ishemiju.

Ključne riječi: *Pneumobilija; Portalna vena – radiografija; Portalna vena – patologija; Embolija, zrak – radiografija; Crijevna ishemija; Radiografija, abdominalna*