

# 83-Year-Old Man With Chronic Kidney Disease, Fluid Overload, and Coronary Artery Disease Develops Altered Mental Status



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An 83-year-old man with a history of chronic kidney disease (stage V) as a result of hypertensive nephrosclerosis and coronary artery disease was admitted to the hospital with dyspnea and bilateral lower extremity edema. Owing to oliguria and progressive renal dysfunction, hemodialysis was initiated the following day via a previously-placed left arm arteriovenous fistula. As a result of delirium and bradycardia, he required prolonged hospitalization. Three weeks into his course, he became hypothermic and obtunded.

Physical examination revealed a thin elderly man with the following vital signs: temperature, 33.8°C; pulse, 55 beats/min; respirations, 20 breaths/min; and blood pressure, 118/80 mm Hg. Cardiovascular examination was significant for bradycardia. Lung examination revealed decreased bibasilar air movement without adventitious sounds. His abdomen was scaphoid and not tender. Extremities showed bilateral 3+ edema to the level of the knees. Laboratory data showed a WBC count of  $4.0 \times 10^3/\text{mm}^3$  (previously 7.1),

potassium of 2.9 mEq/L, and BUN/creatinine of 82/3.65 mg/dL. Owing to the leukopenia, hypothermia, and change in mental status, a sepsis work-up was initiated. A prior chest radiograph (not shown) revealed pleural effusions (right greater than left), bilateral lower lobe infiltrates, and mild pulmonary edema. Bedside abdominal ultrasound (AUS) was performed. The following ultrasound (US) videos were taken with a high-frequency probe over the anterior surface of the liver with the patient at 20° upright ([Videos 1, 2](#)).

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**Question:** Based on the clinical information and US videos, what is the most likely diagnosis?

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**ABBREVIATIONS:** AUS = abdominal ultrasound; AXR = abdominal X-ray; EPSS = enhanced peritoneal stripe sign; US = ultrasound

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## Answer: Pneumoperitoneum

Bedside US over the right lobe of the liver showed enhancement and thickening of the peritoneum with “comet tail” and “ring down” artifacts, consistent with pneumoperitoneum (Videos 1, 2). Surgery was consulted and confirmatory radiographs were obtained (Figs 1, 2). The patient’s age, declining status, multiple medical comorbidities, hypoalbuminemia, and evolving hemodynamic stability were reasons that exploratory laparoscopy was not pursued. CT imaging confirmed pneumoperitoneum with large air collection next to the second portion of the duodenum (not shown). The patient’s course improved with medical management, and surgery was not required. The cause of pneumoperitoneum was secondary to a perforated duodenal ulcer that spontaneously sealed.

## Discussion

Video 3 is a presentation of the Discussion topics. With the ability to image viscera, gallbladder, kidneys, and aorta, AUS as a bedside diagnostic modality for patients with acute abdominal pain, sepsis, and shock is growing. Pneumoperitoneum is often related to a perforated viscus and usually presents with peritonitis. Although this case was managed conservatively, pneumoperitoneum requires urgent surgical intervention in 90% of patients.<sup>1</sup> With severe and acute abdominal pain, abdominal x-ray (AXR) or CT scans are often ordered reflexively. AUS should be considered in the critically ill and is likely underutilized by intensivists.



Figure 1 – Upright portable chest radiograph shows the presence of free air under the diaphragm.



Figure 2 – Left lateral decubitus abdominal radiograph shows the presence of a large pneumoperitoneum.

When gas is introduced into the peritoneum, bubbles form. Acoustic reflection develops when the US pulse reaches both the proximal and distal surface of the bubble.<sup>2</sup> As a result, the transducer probe recognizes cyclic reverberating echoes (eg, A-lines and B-lines) caused by even a small volume of air.

Owing to air’s strong acoustic reflection and resultant sonographic artifacts, pneumoperitoneum produces several distinctive signs. The most well-recognized is the “enhanced peritoneal stripe sign” (EPSS), which was reported in 1999 (Videos 1, 2).<sup>1</sup> The peritoneal stripe is normally thin and faint, located between the abdominal wall and the peritoneum. A single or double line may be seen. With the introduction of air (volumes as small as 1-2 mL), the peritoneal stripe becomes enhanced, thicker, and more echogenic. A large trial of 600 consecutive patients (21 with pneumoperitoneum) presenting with acute abdominal pain confirmed the utility of the EPSS, reporting no false-negative and 3 false-positive cases.<sup>3</sup> Posterior ring down or comet tail artifacts (Video 2) may also be seen. Ring down artifact is distinguished by the echoes maintaining their width distally. Finally, patients with ascites may also show clear air bubbles, diagnostic of intraperitoneal air.<sup>4</sup> Indirect findings consistent with pneumoperitoneum include intraabdominal fluid collections and local ileus.

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