

Is there free air in the abdomen?

N.X. de Rijk^{1*}, F.B.M. Sanders², F.T.J. Boereboom³, L.E.M. Haas¹

Departments of ¹Intensive Care Medicine, ²Radiology, and ³Internal Medicine, Division of Nephrology, Diaconessenhuis, Utrecht, the Netherlands, *corresponding author: tel. +31 (0)88-2505000, e-mail: ndrijk@diakhuis.nl

CASE REPORT

A 67-year-old woman was admitted to our ICU because of respiratory insufficiency. Her medical history revealed a microscopic polyangiitis with mild renal dysfunction, for which she was treated with prednisolone (30 mg once daily) and cyclophosphamide (100 mg once daily). The chest X-ray (CXR) on admission showed bilateral consolidation. Mechanical ventilation was started and because of her immunocompromised state a bronchoalveolar lavage was performed. *Pneumocystis jirovecii* pneumonia (PJP) was diagnosed for which she was treated with trimethoprim-sulfamethoxazole and corticosteroids. Cyclophosphamide was discontinued. Despite treatment, the bilateral consolidation persisted. Acute respiratory distress syndrome (ARDS) and congestion were considered and she was treated with continuous venovenous haemofiltration with rigorous fluid removal and high-dose methylprednisolone. However, the consolidation still persisted (*figure 1*).

Figure 1. Chest X-ray



WHAT IS YOUR DIAGNOSIS?

See page 232 for the answer to this photo quiz.

ANSWER TO PHOTO QUIZ (PAGE 228)
IS THERE FREE AIR IN THE ABDOMEN?

DIAGNOSIS

A false impression of a pneumoperitoneum. The CXR seems to show free air below the diaphragm. A pneumoperitoneum due to an intestinal perforation masked by high-dose corticosteroids or pneumothorax with pneumoretroperitoneum and break through to the peritoneum was suspected and a computed tomography (CT) scan of the chest and abdomen was performed. This ruled out free intraperitoneal air (*figure 2*) and pneumothorax (not shown), but showed that the lung tissue just adjacent to the diaphragm was much less affected by the ARDS than the rest of the lower lobes, which gave the false impression of pneumoperitoneum on the conventional image.

DISCUSSION

Plain radiographs can be misleading in diagnosing free intraperitoneal air.

Although plain radiographs can be helpful in diagnosing a bowel perforation by showing the presence of free intraperitoneal air on an upright CXR, it cannot be relied upon to exclude it.^{1,2} Free air is missed on an upright posteroanterior CXR in 20-62% of cases.^{3,4} However, in most cases plain radiography is sufficient. Incorporation of a left lateral decubitus abdominal radiography showed to improve the sensitivity to detect pneumoperitoneum.⁵

Ultrasonography (US) is an alternative diagnostic modality and showed to be superior to plain radiography in the diagnosis of pneumoperitoneum and when both upright CXR and US are combined, sensitivity can further be increased.^{6,7}

CT has demonstrated to be the most sensitive imaging test for detection of pneumoperitoneum (sensitivity 83-100%), but it would not be cost-effective or justified if all patients with suspected hollow-organ perforation were to undergo CT examinations, since most free air can be detected by plain radiography.^{4,8,9} CT can be reserved for patients with suspected hollow organ perforation where plain radiography and US still fail to make the diagnosis. Surgery is still the 'gold standard' for the diagnosis of pneumoperitoneum.

In retrospect, an US might have been helpful in this patient to rule out pneumothorax, although the actual diagnosis would still be missed.

In this case, the lung tissue just adjacent to the diaphragm was much less affected by the ARDS than the rest of the lower lobes, which gave the false impression of pneumoperitoneum on the conventional image. The distribution of affected areas in ARDS may follow different patterns according to the nature of the underlying disease. The ARDS in this patient was thought to be pneumonia-induced (PJP) or vasculitis induced. Pneumonia-induced ARDS roughly corresponds to the initial infected area, and since PJP often affects the perihilar areas, this might be why the lower areas of the lungs in our patient were relatively free of consolidations.

REFERENCES

1. Roh JJ, Thompson JS, Harned RK, Hodgson PE. Value of pneumoperitoneum in the diagnosis of visceral perforation. *Am J Surg.* 1983;146:830-3.
2. Chiu YH, Chen JD, Tiu CM, et al. Reappraisal of radiographic signs of pneumoperitoneum at emergency department. *Am J Emer Med.* 2009;27:320-7.
3. Woodring JH, Heiser MJ. Detection of pneumoperitoneum on chest radiographs: comparison of upright lateral and posteroanterior projections. *AJR Am J Roentgenol.* 1995;165:45-7.
4. Stapakis JC, Thickman D. Diagnosis of pneumoperitoneum; abdominal CR vs upright chest. *J Comput Assist Tomogr.* 1992;16:713-6.
5. Chen SC, Wang HP, Chen WJ, et al. Selective use of ultrasonography for the detection of pneumoperitoneum. *Acad Emerg Med.* 2002;9:643-5.
6. Chen SC, Yen ZS, Wang HP, Lin FY, Hsu CY, Chen WJ. Ultrasonograph is superior to plain radiography in the diagnosis of pneumoperitoneum. *Br J Surg.* 2002;89:351-4.
7. Chen CH, Yang CC, Yeh YH. Role of upright chest radiography and ultrasonography in demonstrating free air of perforated peptic ulcers. *Hepatogastroenterology.* 2001;48:1082-4.
8. Woodring JH, Heiser MJ. Detection of pneumoperitoneum on chest radiographs; comparison of upright lateral and posteroanterior projections. *AJR Am J Roentgenol.* 1995;165:45-7.
9. Lee FT Jr, Leahy-Gross KM, Hammond TG, Wakeen MJ, Zimmerman SW. Pneumoperitoneum in peritoneal dialysis patients; significance of diagnosis by CT. *J Comput Assist Tomogr.* 1994;18:439-42.

Figure 2. CT scan showing diffuse consolidations of both lungs with relatively normal lung tissue in the lower areas of both lungs

