

TITLE: “The double gut point: a novel sonographic sign of pneumoperitoneum”

ABSTRACT

Background: Pneumoperitoneum is a life-threatening condition, caused by hollow organ perforation. The diagnosis is often difficult, and Point-of-care ultrasound (POCUS) can be useful to distinguish from different conditions, and early set the indication of urgent surgery.

Case Report: A critically ill patient presented to the Emergency Department (ED) with sudden increase in upper abdominal pain and distension with a preliminary diagnosis of small bowel obstruction (SBO) on ultrasound using a curvilinear probe. After repeating the ultrasound using a linear probe, two dynamic points at mesogastrium very similar to the “double lung point” seen in thoracic ultrasound was detected. This “double gut point” due to bowel ischemia leading to intestinal necrosis and perforation was confirmed on a computed tomography scan.

Why Should an Emergency Physician Be Aware of This?

In this case, the finding of an abdominal “double gut point” allowed us to diagnose pneumoperitoneum, being a novel sign not previously described, that could aid to diagnose small amounts of free air in the peritoneal cavity.

Keywords: pneumoperitoneum; free air; abdominal ultrasound; abdominal pain; hollow-organ perforation; double gut point.

1. INTRODUCTION

Abdominal pain is one of the most common presenting complaints to the Emergency Department (ED). The differential diagnosis is extensive, with many etiologies having the same initial presentation, which could change the management and therefore the prognosis.

Pneumoperitoneum is a life-threatening situation, caused by hollow organ perforation. The first diagnostic approach is made with the help of abdominal or chest X-Ray, however according to an early study, in almost 50% of the cases the diagnosis cannot be made due to interpretative difficulties (1). Abdominal CT, as a gold standard for assessment of pneumoperitoneum, it is not always available or the patient is hemodynamic unstable to be taken.

In the diagnostic evaluation, Point-of-care ultrasound (POCUS) can be used by emergency physicians as a goal-directed examination meant to answer specific questions. It is a sensitive, non-invasive and reproducible test. It allows to rule-in the presence of different conditions such as biliary disease, nephrolithiasis, gynecologic problems, bowel disease, vascular complications or existence of internal bleeding, which could modify the management or even set the indication of urgent surgery.

The typical ultrasound findings in pneumoperitoneum are an enhancement of the peritoneal stripe sign (EPSS) (2), the presence of free fluid and a ring-down artifact that shift with patient position (3), these findings require a certain degree of expertise to detect (4).

2. CASE REPORT

We herein report a case of a 90-year-old Caucasian man with previous history of hypertension, cholecystectomy, appendectomy and benign prostate hypertrophy, who presented in the ED with sudden increase in upper abdominal pain and distension. The patient had been experiencing intermittent abdominal pain, vomiting and diarrhea for the past 3 days, unrelieved with omeprazole and loperamide, prescribed by his primary care physician. Physical exam showed abdominal rebound tenderness. He had a BP of 108/68 mmHg, Heart rate 96 bpm, axillary temperature 35.3 °C and SpO₂ 96%. Laboratory workup was remarkable for WBC 12,100/ μ L [3,700-11,600] (91% neutrophils; 3.9% lymphocytes), hemoglobin 9.8 g/dL [11.5-15.5], platelet 230,000/ μ L [150,000-400,000], Na 129.5 mmol/L [135-145], urea 217 mg/dL [10-40 mg/dL], ALT 34 IU/L [10-35], total bilirubin 0.4 mg/dL [0.3-1.9], albumin 17 g/L [34-50], creatinine 6.1 mg/dL [0.7-1.3] (GFR 7.4 mL/mn/1.73m² [>90]), CRP 382 mg/dL [0.0-3.0]. The rest of laboratory tests were normal. Abdominal X-ray was unremarkable.

A POCUS was performed, using a curvilinear transducer (video 1), showing signs of small bowel obstruction (SBO). No signs of hydronephrosis, abdominal aortic aneurism (AAA) or biliary complication were detected. Initial decompression was performed by placement of a nasogastric tube, which did not improve the comfort.

In this critically ill patient, in whom SBO could not explain the severity of the symptoms and the lack of pain relief with therapy, the ultrasound was repeated using a linear probe, detecting two points at mesogastrium (video 2) very similar to the “double lung point” seen in thoracic ultrasound (5). This “double gut point” is explained by the presence of

air that is not free in the peritoneal cavity, and forms a bulla surrounded by adherent peritoneal layers.

Bowel ischemia leading to intestinal necrosis and perforation, in the setting of small bowel obstruction, was diagnosed on the basis of these results, confirmed later with abdominal CT.

General surgery ward was consulted, who after assessing the high mortality risk of surgery, followed by family and patient consent, decided to start palliative care measures.

The patient died 36 hours later.

3. DISCUSSION

Acute abdominal pain is one of the most common complaints seen in the Emergency Department (ED), and it can be life threatening if not early evaluated and correctly diagnosed. The increasing demand for a quality and timely emergency care, might increase the number of unnecessary investigations, such as plain abdominal radiography, leading to an overwhelming number of ionizing tests with normal results, waste of time and financial resources.

The definitive need for computed tomography (CT) in complicated cases is undeniable, as management of many diseases is largely determined by CT findings as well as ruling out other differentials diagnosis. However, CT scans cost more, take more time, require evaluation of kidney function, require contrast a lot of the times and expose patients to high doses of ionizing radiation.

The utility and scope of point-of-care ultrasound (POCUS) for evaluating and managing abdominal complaints in the ED has grown rapidly with little change in physician practice or patient awareness (6). Despite its increasing availability in every ED, POCUS is underused in evaluating many common abdominal chief complaints in the ED (7). In 2012 the “Ultrasound First Forum” met and created the Ultrasound First Campaign (7) to encourage research and change practices in clinical situations where initial evaluation with POCUS may be safer, less costly and time consuming. Ultrasound First resulting in equivocal or indeterminate results would guide further imaging decisions. Therefore should be the first imaging study performed, particularly when the patient is hemodynamic unstable.

Although POCUS is not meant to diagnose pneumoperitoneum, it can be detected during a focused study to rule-in other pathologies. When compared to X-ray, it showed a much higher sensitivity (79% vs 97%) (8).

In supine position, free air will tend to accumulate anterior over the liver and epigastrium. A curvilinear probe can be used to initiate the abdominal POCUS examination, in the search of free fluid and rule-in causes of abdominal pain, but a second scan with a linear probe can be more sensitive to detect signs such as the EPSS (2), which is the presence of air against the anterior abdominal wall, resulting in an enhancement of the peritoneum. Consequently, switching probes should be part of our dynamic examination of the pneumoperitoneum,

In our case, it was possible to visualize 2 gut points (“double gut point”), which was found at mesogastrium, lower than expected. This abdominal “double gut point” has not

been previously labeled as such, being a novel sign to diagnose small amounts of free air in the peritoneal cavity (not only over the liver or epigastrium), and searching for this specific sign, in combination with the previously described, could aid to diagnose pneumoperitoneum.

Video 1. Curvilinear probe. Midline abdominal transverse view, showing dilated bowel loops, with back and forth peristalsis, compatible with Small Bowel Obstruction.

Video 2. Linear probe. Same spot as before, showing a double gut point, compatible with pneumoperitoneum.

No potential conflicts of interest were disclosed.

REFERENCES:

1. Menuck L, Siemers PT. Pneumoperitoneum: importance of right upper quadrant features. *AJR Am J Roentgenol.* 1976 Nov;127(5):753–6.
2. Muradali D, Wilson S, Burns PN, Shapiro H, Hope-Simpson D. A specific sign of pneumoperitoneum on sonography: enhancement of the peritoneal stripe. *AJR Am J Roentgenol.* 1999 Nov;173(5):1257–62.

3. Jones R. Recognition of pneumoperitoneum using bedside ultrasound in critically ill patients presenting with acute abdominal pain. *Am J Emerg Med.* 2007 Sep;25(7):838–41.
4. Scott Bomann J, Van Tonder R, Hernandez S, Moore C. Abdominal a-lines: a simpler sonographic sign of pneumoperitoneum? *Crit Ultrasound J.* 2011 Apr;3(1):41–2.
5. Volpicelli G, Audino B. The double lung point: an unusual sonographic sign of juvenile spontaneous pneumothorax. *Am J Emerg Med.* 2011 Mar;29(3):355.e1–355.e2.
6. Rodgers PM, Verma R. Transabdominal Ultrasound for Bowel Evaluation. *Radiol Clin North Am.* enero de 2013;51(1):133-48.
7. Minton KK, Abuhamad A. 2012 ultrasound first forum proceedings. *J Ultrasound Med.* 2013;32(4):555–566.
8. Chen S-C, Wang H-P, Chen W-J, Lin F-Y, Hsu C-Y, Chang K-J, et al. Selective use of ultrasonography for the detection of pneumoperitoneum. *Acad Emerg Med Off J Soc Acad Emerg Med.* 2002 Jun;9(6):643–5.