Yet another Case of Abdominal Pain: Pneumoperitoneum Diagnosis via Ultrasound

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Section 2 – Answer

Case

A 70-year-old woman with an unknown medical history and no regular medical follow-up was admitted in the emergency department due to abdominal pain persisting for 2 weeks, which had worsened 2 h before her first medical contact.

She was transported to the emergency room due to severe hypoxemia and hemodynamic instability. She was tachypneic (respiratory frequency of 22 bpm) with an oxygen delivery of 10 L/min through facial mask to maintain a peripheral saturation of 92%. Her heart rate was 93 bpm and her blood pressure was 62/35 mmHg, with cold and cyanotic extremities. The signs of severe dehydration were evident, with a reduced and concentrated amount of urinary output after catheterization. Her Glasgow Coma Score was 14. She was hypothermic (34.5°C), exhibited poor hygiene, and was in a state of severe cachexia. Her abdomen was distended, tender, and tympanic, without palpable masses or indurations.

Blood gas sample revealed compensated metabolic acidosis (lactate of 8 mmol/L, pCO2 22 mmHg, HCO3 19, anion gap 27 mmol/L, and pH 7.55). Blood workout revealed hemoglobin of 12.9 g/dL (normal range [NR] 12.0–16.0), serum sodium of 132 mmol/L, uremia of 165 mg/dL (NR 17–50), creatinine of 1.03 mg/dL (NR 0.51–0.95), myoglobinolysis at 203 ng/mL (NR 28–58), and a C-reactive protein of 39 mg/dL (NR <0.5), without leukocytosis. Figure 1 shows the point-of-care ultrasound (POCUS) immediately performed (ACUSON 5C1 curvilinear probe, 1.0–5.7 MHz).

What is the most likely diagnosis?

Interpretation

Abdominal point-of-care ultrasound (POCUS) assessment of the periumbilical region [Figure 1] demonstrated A-lines (arrow), reverberation artifacts that represent repetitions of the parietal peritoneum (arrowhead), indicating the presence of a pneumoperitoneum. The computed tomography (CT) of the abdomen done after [Figure 2] corroborated the diagnosis, demonstrating a large bowel perforation of nonclarified cause (assumed as a nondiagnosed tumor or embolic phenomena). Given the patient's poor performance status, surgical aggressiveness was not considered beneficial due to limited potential of recovery and end-of-life care measures were implemented.

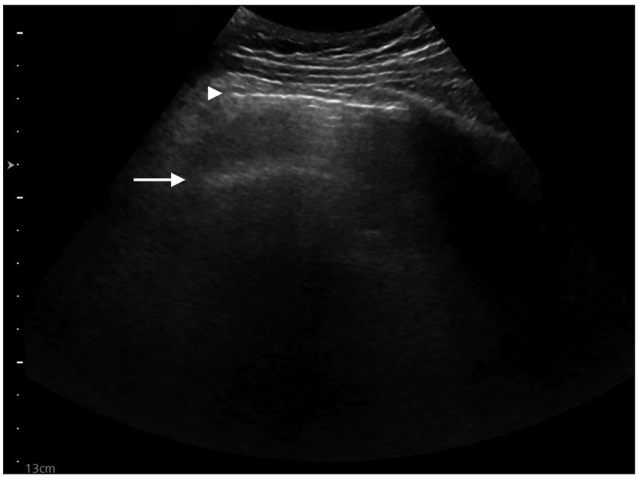

Figure 1: Ultrasound image of the periumbilical region of the abdomen. A-lines (arrow), parietal peritoneum (arrowhead)

Discussion

Abdominal pain is a very common cause of emergency

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Figure 2: Computed tomography of a transverse plane of the abdomen

department admission. It is the major symptom of underlying pneumoperitoneum, which is caused by a perforated hollow viscus in 85%–90% of cases. Differential diagnosis includes peptic ulcer disease, diverticulitis, trauma, and malignancy.[1] Classic imaging diagnosis by radiography shows free intraperitoneal air under the diaphragm in an upright plain exam, but the gold standard pneumoperitoneum diagnostic tool is the CT.[2] Despite this, abdominal POCUS can be as accurate as these imaging modalities in many urgent abdominal pathologies, including pneumoperitoneum, with A-lines being the most typical feature seen.[1,3]

A-lines were first described in the pulmonary context as repeated bright horizontal artifacts below the pleural line, resulting from the tissue-air interface, a strong reflector of ultrasound waves.[1] These can characterize different clinical scenarios, including pneumothorax, when combined with other ultrasound findings, such as "lung point."[4] In the abdominal POCUS context, A-lines can indicate free intraperitoneal air, with peritoneum as the tissue interface. A high-frequency linear probe is the most adequate tool to detect air in the abdominal cavity, with the patient in a supine position.[3] Besides A-lines, other typical ultrasound findings that point out for the diagnosis of pneumoperitoneum include the enhanced peritoneal stripe sign, which consists in a characteristic thick hyperechoic line created by the contact between free air and the peritoneum. In addition, the "gut point", analogous to the "lung point", results from the transition between peritoneal sliding and its pathologic abolishment by the free air, identified in m-mode as an alteration between seashore and stratosphere patterns. These findings require a greater degree of expertise to detect compared to A-lines.[2,3]

Abdominal POCUS is emerging as an important tool in pneumoperitoneum detection, especially in hemodynamically unstable patients or when immediate radiological imaging is not available. Although CT remains essential for pneumoperitoneum diagnosis and surgical planning, abdominal POCUS plays an important role in early identification, expediting surgical consultations and interventions, and later improving patient outcomes.[5,6] However, its effectiveness can be limited by operator dependency, patients' cooperation, abdominal obesity or subcutaneous emphysema, potential pitfalls of such technique. Besides, A-lines can also be found in cases of intestinal obstruction, gastrointestinal paralysis or flatulence (in which we can find abundant intra-intestinal gas), even though there is no pneumoperitoneum associated.[7] Thus, ongoing education and research are necessary to fully realize POCUS's potential in increasing diagnostic accuracy, transforming it from a routine bed-side tool to a point-of-care imaging tool in critical abdominal care patients, and permitting a short cut for a definitive surgical management. This holds tremendous potential for health-care cost reduction, especially valuable in resource-poor hospitals.

Conclusion

The utilization of POCUS has dramatically changed diagnostic practices in emergency and critical care settings, offering rapid, bedside evaluations that can substantially impact patient management. Among the numerous applications of POCUS, the identification of abdominal A-lines, and subsequently, the detection of free intraperitoneal air are particularly noteworthy for their diagnostic implications of life-threatening conditions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent form. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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