

Pneumoperitoneum, does it have any clinical significance?

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Abstract

Pneumoperitoneum is a life-threatening diagnosis that requires timely diagnosis and action. We present a case series of patients with perforated hollow viscus who were accurately diagnosed by emergency physicians using point-of-care ultrasound (POCUS) while in the emergency department (ED). It can also be detected on x-ray, but small amounts of free peritoneal air may be missed and are often detected on computerized tomography (CT) [1]. The most common cause of a pneumoperitoneum is a perforation/disruption of the wall of a hollow viscus.

Keywords: Emergency medicine; point of care ultrasound; pneumoperitoneum; free intraperitoneal air; case series.

Case 1

A 51-years-aged gentleman, a known CAD - S/P cardiac arrest reversion for AWWMI(STEMI), S/P CABG with IABP, and PCI to proximal and mid LAD, came here with complaints of fever for one day-high grade, intermittent. No history of cough/cold/nausea/vomiting/loose stools/abdominal pain. No history of chest pain/palpitation/sweating/decreased urine output. He had a recent history of cardiac arrest - secondary to AWWMI (STEMI). Post that event, he developed hypoxic ischemic encephalopathy following which a tracheostomy was done. He was started on PEG feeds in view of the long-standing need for feeds considering he was already bed bound and had history of recurrent aspiration. The PEG needed a replacement as his existing PEG tube seemed to be displaced.

On examination in the ED

- Patient was drowsy, but arousable, febrile at 101°F, poorly hydrated.
- Tachycardic at 158/min
- Hypotensive with a BP of 80/60 mmHg
- Mildly tachypnoeic at 28/min with SpO₂: 96% room air
- CBG:194 mg/dl

Systemic examination

- Post Tracheostomy Status. No signs of obstruction
- B/L vesicular breath sounds
- S1S2 +, PSM (pansystolic murmur) +, JVP-normal, Pallor +, PPWF (peripheral pulses well felt) +, P/A: Distended, hyper-resonant note on percussion, BS+, PEG Tube in-situ
- E4V1M3, B/L PERL 2 mm
- Tracheostomy Tube in situ. Clear. No secretions

Bedside Investigations

ABG	CHEM - 8
PH: 7.52	NA:146
PCO ₂ : 25	K:4.2
PO ₂ : 75	CL:115
HCO ₃ : 19.1	GLU: 143
TCO ₂ : 20	BUN: 55
LAC: 1.28	CR: 1.3
	HB: 7.8

Provisional diagnosis

Acute febrile illness - R/O Severe sepsis, Peritonitis

Course of illness

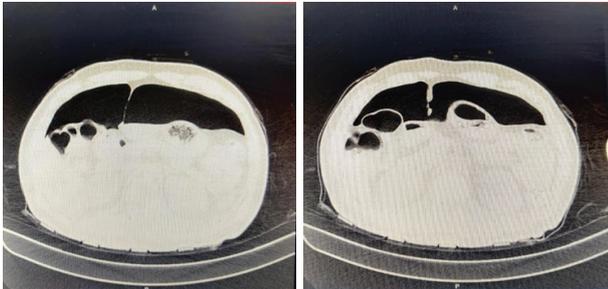
Initially in view of high temperature, he was treated with IV antipyretics (Paracetamol 1 gm) was given, and in view of hypotension, IV fluid NS 250ml bolus, following which his BP was 100/60, and he was continued on maintenance of NS@50ml/hr.

In view of abdomen distension and hyper-resonance, there was a suspicion of peritonitis.

Point-of-care ultrasound of abdomen showed thin rim of free air in the abdomen (like a thick stripe in the peritoneum), which indicated the possibility of pneumoperitoneum.

CT of the abdomen was expedited, which showed:

- Pneumotosis Intestinalis of the distal ileum
- Massive Pneumoperitoneum & Loaded Rectum



CT Chest was done in view of recurrent aspiration in the past; it showed Right Lower Lobe densities - features of atelectasis. No features suggestive of Covid 19 or pneumonia.

Case 2

A 68-years-aged lady, known to have a neuro-endocrine tumor in first part of duodenum S/P Laparoscopic D resection + ROUX EN Y gastrojejunostomy + jejuno-jejunostomy (Nov 2021), presented to emergency room, with history of bilateral loin to groin pain – gradual in onset, associated with nausea and one episode of vomiting (contains food particle, non-bilious, not blood stained) since two days – which worsened since that morning.

She also gave a history of decreased urine output (last voided that morning) and inability to pass stools and flatus since that morning. No history of outside food intake, cough, cold, chest pain, palpitation, sweating, breathing difficulty, giddiness, headache, LOC, seizure, syncope.

On Examination

- She was conscious, oriented, afebrile, dehydrated
- Mildly tachycardic at HR: 112 b/min, BP: 100/60mmHg, SpO₂: 96% @ RA
- CBG: 175 mg/dl

Systemic examination

- CVS: S1S2 heard. No murmur
- RS: Normal vesicular breath sounds, no added sounds.

- P/A: Soft. left iliac fossa tenderness +, sluggish bowel sounds +.
- CNS: E4V5M6 moving all four limbs.

Provisional Diagnosis

- Acute Abdomen

Investigations:

ECG showed: rate: 110/ min, sinus tachycardia, normal axis, no ST – T changes.

Electrolytes: Na+: 138 mmol/l, K+: 4.0 mmol/l, Cl: 1.08 mmol/l, Glucose: 255 mg/dl, Creat: 0.7 mg/dl,

VBG: pH: 7.29, pCo₂: 46.9 mmhg, pO₂: 42 mmhg, Beecf: -4 mmol/l, HCO₃: 22.7 mmol/l, Lactate: 3.65 mmol/l

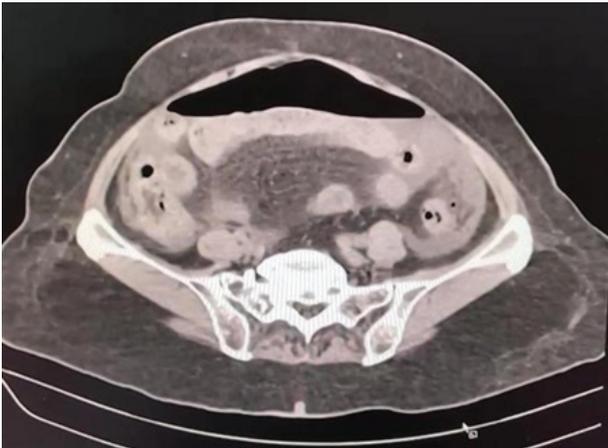
In view of abdominal pain, she was initially treated with IV analgesics and proton pump inhibitors, and reassessed after 20 min, but she still had a pain score of 7/10, hence, she was treated with IV opioid analgesics and antiemetics.

Point-of-care ultrasound abdomen screening was done which showed free fluid in the abdomen. It also showed gas bubbles in the ascitic fluid, suspicious of a perforation. So, once her pain settled, she was shifted for CT abdomen which confirmed the diagnosis.



CT abdomen showed: Mild Ascites with pneumoperitoneum, Partial distal gastrectomy with gastro jejunostomy and jejunojejunostomy status

Patient suddenly went to profound hypotension(80/50 mmHg) with respiratory distress.



Initially she was started on oxygen support and IV fluids around 2 L was given but as there was no improvement in her blood pressure, she was started on inotropes - noradrenaline infusion- and then she was shifted to OT for emergency laparotomy.

Discussion

Our case series reports the benefits of point-of-care ultrasonographic detection of pneumoperitoneum in the ED. The diagnosis of pneumoperitoneum is usually identified by radiograph and/or CT. On radiographs, pneumoperitoneum is identified by the presence of subdiaphragmatic free air either in the upright or lateral decubitus position. The sensitivity of CT in detecting free air is 96–100%; In addition, CT is able to identify the specific sites of perforation in 80–90% of cases. Nonetheless, there are circumstances that delay these imaging modalities significantly. Examples include patient's inability to stand or sit for an upright CXR, limited staffing/transport for CT, and hospital protocols that prioritize CT scanners for time-critical illnesses (e.g. code strokes). As seen in two of our cases, there are also instances in which patients are obtunded or unresponsive, making physical exam less reliable even though they may, in fact, have significant underlying pathology. In these cases, POCUS proved to be an excellent diagnostic tool to use at bedside.

Comfort with the POCUS technique is an invaluable skill for emergency physicians for several reasons. A busy ED might have imaging delays with CT scanners occupied with trauma patients or no available patient transporters, and a bedside exam might save the day. Another advantage of POCUS is that it is a quick, no

radiation option in patients who are “too unstable” to leave the department. It is also a more appropriate first choice in pregnant women and infants, in whom we want to reduce risks of radiation.

Ultrasound is more sensitive for free air than plain radiography. One study found ultrasound to have a 95% sensitivity in detecting pneumoperitoneum compared to 78% with plain films [2]. Additionally, ultrasound has improved ability to detect “indirect” findings of bowel perforation, such as decreased peristalsis and free fluid between intestinal loops [3].

Studies have reported a sensitivity of 93% and specificity of 64% for sonographic diagnosis of pneumoperitoneum and an even higher accuracy (sensitivity of 100% and specificity of 99%) when EPSS (Enhanced peritoneal stripe sign) is present [4].

While ultrasound is an accessible, cost-effective, and safe diagnostic tool, it comes with its own limitations. It is highly operator dependent with many factors that can prevent good quality images, including rib shadowing, bowel gas, obesity, and subcutaneous emphysema. [5,6] In addition, some critically ill or agitated patients may not tolerate the ultrasound probe on various regions of the abdomens [6]. Finally, ultrasound cannot identify the exact location of perforation. POCUS is a “rule-in” test and is extremely useful as a screening test to expedite next steps. Given the significant morbidity and mortality associated with this diagnosis, a negative POCUS exam should not be interpreted as an absence of pathology.

Pneumoperitoneum Point-of-Care Ultrasound: Techniques

Purpose:
to detect free air in the abdomen

Probe Selection:
Linear > curvilinear

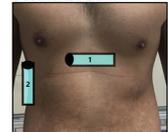
Scissor Technique:

Pressure on the caudal probe will dissipate the reverberation artifacts. Release pressure and the artifacts reappear.

2 Scan FAST Exam:

(1) RUQ/epigastrium in supine position, HOB 10-20 degrees
(2) Left lateral decubitus

2 Scan FAST Exam



Pneumoperitoneum:

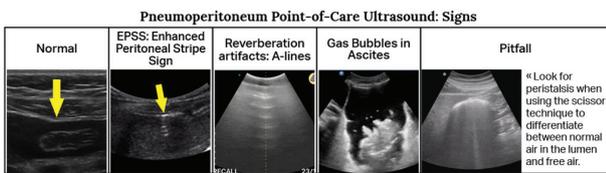
It denotes the presence of air within peritoneal cavity. The cause may be grouped under the following categories:

- Postoperatively retained air,
- Thoracic,
- Abdominal,
- Gynaecological,
- Idiopathic.

Most common causes are

- Perforation of Abdomen viscus,
- Perforated ulcer,
- Trauma,
- Endoscopy Barotrauma,
- Diverticulitis,
- Perforated Appendix(seldom)[2]

They usually present with abdominal pain with rebound tenderness and guarding, nausea and vomiting, loss of appetite, decreased urine output, diarrhea, thirst/bloating. When significant end organ dysfunction due to septic shock and trauma (respiratory cause secondary to trauma - tension pneumothorax should be ruled out) is suspected - one must look for mediastinal shift and Morrison' pouch for signs.



Conclusion

Patient presenting with hypotension, respiratory distress, a tensely distended abdomen and high inspiratory pressures, pneumoperitoneum should be suspected. In this case series, POCUS was used to identify signs of pneumoperitoneum, which helped expedite the CT and appropriate treatments and expert consultation in the Emergency Department. Further studies are required to investigate the effect of performing POCUS on the time to CT and definitive management in patients with abdominal emergencies. Conservative management is warranted in the absence of signs and symptoms of peritonitis.

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References

- [1] Lee CH. Images in clinical medicine. Radiologic signs of pneumoperitoneum. N Engl J Med. 2010;362:2410.
- [2] Chen SC, et al. Ultrasonography Is Superior to Plain Radiography in the Diagnosis of Pneumo-peritoneum. British J Surg. 2002;89(3):2002.
- [3] Grassi R, et al. Gastro-Duodenal Perforations: Conventional Plain Film, US and CT Findings in 166 Consecutive Patients. Europ J Radiol 2004;50(1),30-36.
- [4] Kumar A, Muir MT, Cohn SM, et al. The etiology of pneumoperitoneum in the 21st century. J Trauma Acute Care Surg. 2012;73(3):542-8.
- [5] Hefny AF, Abu-Zidan FM. Sonographic diagnosis of intraperitoneal free air. J Emerg Trauma Shock. 2011;4(4):511-3.
- [6] Grechenig W, Peicha G, Clement HG, et al. Detection of pneumoperitoneum by ultrasound examination: an experimental and clinical study. Injury. 1999;30(3):173-8.
- [7] Giuffre B, Posaw L. A New Mode to Diagnose Pneumo (Peritoneum). 2020.