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CASE REPORT

Abdominal a-lines: a simpler sonographic sign of pneumoperitoneum?

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An 82-year-old female presented to the emergency department with abdominal distension, decreased mental status and a report of no bowel movement for 4 days. She had multiple medical problems including severe dementia. On arrival, she was lethargic but arousable to pain. Her vital signs were normal except for an elevated blood pressure (196/93 mmHg). Her abdomen was severely distended, diffusely tender and suspicious for deep crepitus.

A bedside ultrasound was performed using a curvilinear, low-frequency probe. No abdominal structures were visualized in any area of the abdomen (Fig 1). A second scan was performed using a high-frequency linear probe in the exact same spot as Fig. 1 which showed multiple, equally spaced, horizontal, hyperechoic lines repeating down the screen without any visualization of abdominal organs (Fig. 2). No such lines were seen with the curvilinear probe. This pattern was very similar to the common "a-lines" seen in thoracic ultrasound (Fig. 3). Her X-ray confirmed the sonographic diagnosis of massive pneumopeitoneum. She had severe fecal impaction causing colonic perforation. The patient's family requested comfort care only and she was discharged to hospice.

Ultrasound can detect as little as "a single tiny bubble" of air in the abdominal cavity [1] and the ultrasonic findings of pneumoperitoneum have been well described: echogenic free-fluid, focal hyperechoic bubbles, ring-down artifacts that shift with patient position, "dirty shadowing" and enhancement of the peritoneal stripe with or without a reverberant echo [2–4]. Many of these are subtle findings requiring a certain degree of expertise to detect (Fig. 4).

a-Lines are well known and easily obtained artifacts found in thoracic ultrasound [5]. They arise as a result of a reverberation of the sound waves hitting the strongly reflective pleura, which is superficial to either a well-aerated lung or a pneumothorax. The lung, itself, is not visualized as the air beneath the pleura attenuates the sound waves. Higher frequency probes cause greater attenuation. The "lung" that appears on the screen is merely multiple repetitions of the skin-to-pleura image, a reverberation artifact.

The abdominal a-line has not been previously labeled as such and results from the same mechanism as its thoracic counterpart. The multiple, equally spaced, horizontal lines represent repetitions of the skin-to-parietal peritoneum image and the abdominal organs are not visualized due to the attenuation of the sound waves by the free intra-peritoneal air beneath. Images should be obtained with the patient supine using a linear, high-frequency probe. Different areas of the abdomen should be interrogated to lessen the likelihood of a false-positive exam due to bowel gas. With this technique, abdominal a-lines may be easier to obtain than some of the other known sonographic findings of pneumoperitoneum. For example, our image shows the classic "thickened peritoneal stripe". Unless the sonographer has spent time studying normal peritoneal thickness, this finding could easily be missed. The abdominal a-line is far more obvious.

The many sonographic findings of pneumoperitoneum have been shown to be more sensitive and equally specific to those of X-ray [6]. Further work needs to be done to correlate the presence and size of abdominal a-lines with the

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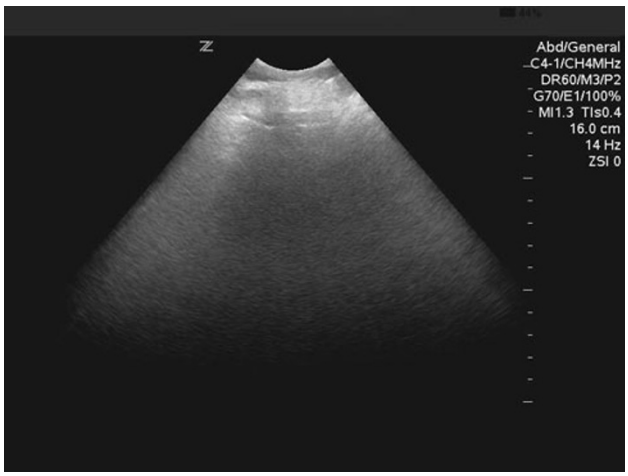

Fig. 1 Curvilinear probe

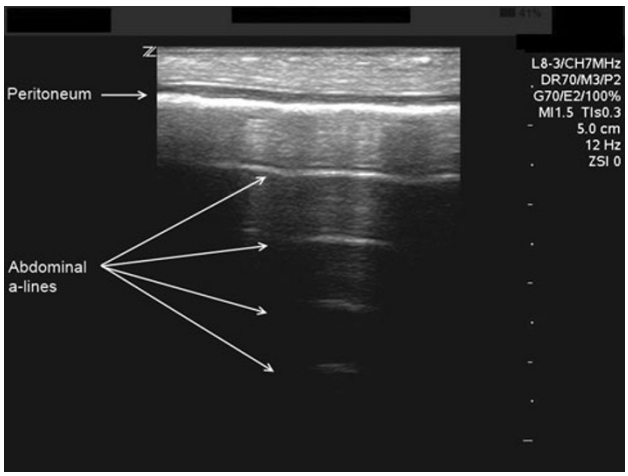

Fig. 2 Abdominal a-lines

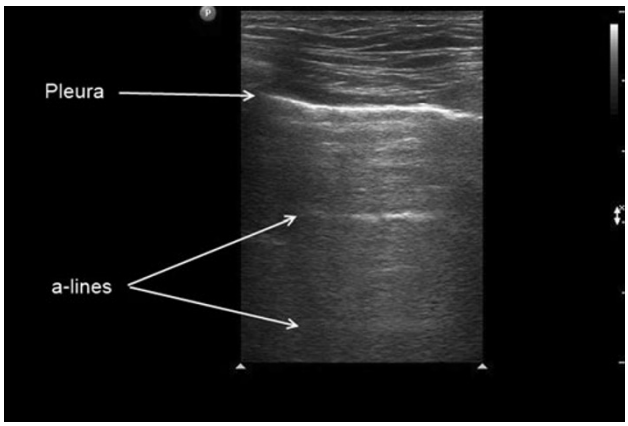

Fig. 3 Thoracic a-lines

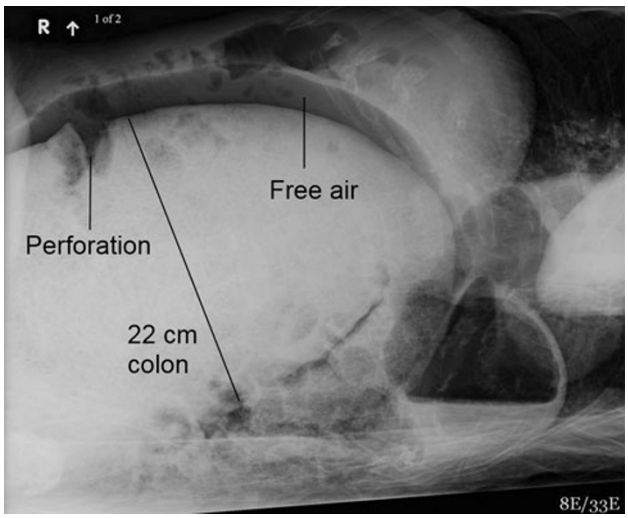

Fig. 4 The image is a left lateral decubitus view of the abdomen showing a perforated colon and massive pneumoperitoneum

sensitivity and specificity of the diagnosis of pneumoperitoneum and/or the quantity of free air within the abdominal cavity.

Conflict of interest None.

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