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Radiological Findings of Pneumoperitoneum in Suspected Gastric Perforation in an Elderly: A Case Report

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Abstract: ***Introduction: Pneumoperitoneum is a medical emergency, defined as the free air presence in the peritoneal cavity [1]. The most common cause of pneumoperitoneum in adults are perforation, peritoneal dialysis, immediate postoperative status, vaginal aspiration, and mechanical ventilation. Mechanical perforations can appear after colonoscopy, endoscopy, and others [2]. There are some radiological examinations to evaluate pneumoperitoneum including plain radiographs abdomen, ultrasound, MRI, CT scan with and without contrast. Usually plain radiographs can provide significant and sensitive findings indicates the presence of abnormal intraperitoneal air in an emergency setting, however small amounts of free peritoneal air may be missed and new enclosures can be detected using computerized tomography (CT) [2].***

1. Case Report

A 76-year-old man was referred to Bangli Hospital with black colored stools since 3 days before hospitalized and also pain in his whole stomach. The patient has a history of gastritis 5 years ago and frequently taking pain medication. When he arrived, his temperature was 36.7 °C, 103 beats/minute of pulse, 20 breaths/minute of respiratory rates and 140/80 mmHg of blood pressure. Physical examination showed diffuse pain throughout the stomach, distended on palpation and slight increase of bowel sounds on auscultation. Initial complete blood count showed 12.1 g/dl of hemoglobin, 11.6 x 10^3/uL of leukocytes, 1.94 mg/dl of creatinine, and 131.9 mmol/L of sodium. In Figure 1, the x-ray photo shows evidence of pneumoperitoneum. The next day an ultrasound examination (USG) was performed to see any specific free air in the peritoneum and also the function of several organs like liver, spleen, pancreas, and kidneys. Abdominal ultrasound also showed the signs of pneumoperitoneum. After confirmed by several complementary examinations, the patient was referred to Sanglah General Hospital for any advanced surgery such as laparotomy by digestive surgeon.

2. Summary

The diagnosis of the patient is based on the history, physical examination, and complementary examination in the form of chest X-rays and plain abdominal radiograph with an erect position [1]. Although left lateral decubitus (LLD) images were not performed, images on the chest X-rays and plain abdominal radiograph in erect position are quite clear to show the presence of large amount of free air in a massive pneumoperitoneum. Gastric perforation was suspected as the cause of pneumoperitoneum in this patient due to the patient's age and history of pain medication for his chronic gastritis. To determine the etiology also the definitive treatment for pneumoperitoneum in this patient, laparotomy procedure or other operative technique was performed with the consideration of a digestive surgeon as pneumoperitoneum is a medical emergency due to the presence of free air in the peritoneal cavity [1]. Because there is no digestive surgeon and adequate operating facilities at Bangli Hospital, the patient was referred to Sanglah General Hospital for further treatment.

3. Introduction

Pneumoperitoneum is a medical emergency, defined as the free air presence in the peritoneal cavity [1]. The most common cause, which is more than 90% of the pneumoperitoneum is a perforation of the gastrointestinal tract where the perforation of the stomach or duodenum caused by peptic ulcer as the most causes often. In addition, pneumoperitoneum can also be caused by a diverticular rupture as well as the direct effects of abdominal trauma. Pneumoperitoneum causes in children are different from the adult population. The most common cause of pneumoperitoneum in adults are perforation, peritoneal dialysis, immediate postoperative status, vaginal aspiration, and mechanical ventilation. Mechanical perforations can appear after colonoscopy, endoscopy, and others [2]. There are some radiological examinations to evaluate pneumoperitoneum including plain radiographs abdomen, ultrasound, MRI, CT scan with and without contrast. Usually plain radiographs can provide significant and sensitive findings indicates the presence of abnormal intraperitoneal air in an emergency setting, however small amounts of free peritoneal air may be missed and new enclosures can be detected using computerized tomography (CT). Addition of contrast is important because sometimes small amounts of free peritoneal air may be missed and this condition can lead to death if not treated immediately [2].

4. Case Report

A 76-year-old man was referred to Bangli Hospital with black colored stools since 3 days before hospitalized and also pain in his whole stomach. The patient has a history of gastritis 5 years ago and frequently taking pain medication. When he arrived, his temperature was 36.7 °C, 103 beats/minute of pulse, 20 breaths/minute of respiratory rates and 140/80 mmHg of blood pressure. Physical examination showed diffuse pain throughout the stomach, distended on

palpation and slight increase of bowel sounds on auscultation. Examination of the respiratory, cardiovascular, genitourinary and nervous systems within normal limits. Digital rectal examination found adequate anal spincter tone (+), smooth mucosa, no rectal mass, and black stools. Working diagnosis on that time was observation of melena *et causa* suspected gastric perforation.

Initial complete blood count showed 12.1 g/dl of hemoglobin, 11.6 x 10^3/uL of leukocytes, 1.94 mg/dl of creatinine, and 131.9 mmol/L of sodium. In Figure 1, the x-ray photo shows evidence of pneumoperitoneum, namely: cupola/saddlebag/mustache signs seen on radiographic with erect position, it refers to the accumulation of air under the central tendons of the diaphragm below right lung (white arrow). Figure 2 shows the falciform ligament sign (white arrow), Rigler sign (blue arrow), and telltale triangle sign (white arrowhead). The next day an ultrasound examination (USG) was performed to see any specific free air in the peritoneum and also the function of several organs like liver, spleen, pancreas, and kidneys. Abdominal ultrasound also showed the signs of pneumoperitoneum. After confirmed by several complementary examinations, the patient was referred to Sanglah General Hospital for any advanced surgery such as laparotomy by digestive surgeon.

Figure 1: The cupola / saddlebag / mustache sign (white arrow) seen on the chest radiograph shows the accumulation of air under the central tendon of the diaphragm below the right lung.

Figure 2: Falciforme ligament sign (white arrow), Rigler's sign (blue arrow), telltale triangle sign (white arrowhead)

5. Discussion

Gastrointestinal perforation with leakage of digestive contents into the peritoneal cavity is a common surgical emergency that can be life-threatening. It can occur spontaneously or caused by direct trauma [3]. Gastrointestinal perforation caused by gastric ulcers is considered to be the most etiology of generalized pneumoperitoneum. Radiological examination forms the basis of the pneumoperitoneum diagnosis. In acute circumstances, x-rays are very important because beside its role to assist pneumoperitoneum diagnosis, it also provides information about other vital organs function such as cardiomegaly, pneumonia, and presence of masses and metastases of cancer [3]. In this case report, a 76-year-old man was referred to Bangli Hospital with main symptom of black colored stools since 3 days before hospitalized accompanied by pain throughout stomach. At physical examination there was diffuse pain throughout the abdomen, distended on palpation and slight increase of bowel sounds on auscultation. Digital rectal examination found strong anal spincter tone (+), smooth mucosa, no rectal mass, and black colored stools. Working diagnosis on that time was observation of melena *et causa* suspected gastric perforation.

A case report by Ahmed M. Makki conducted 131 cases of pneumoperitoneum in emergency laparotomy. Research reviews that gastro-duodenal area is the most frequent site of perforation (42%) followed by large intestine, small intestine and the smallest appendix area. Acute appendicitis is a rare underlying cause of intraabdominal air leakage, with a reported incidence of 0-7% [4].

Optimal radiographic technique is essential in cases that abdominal perforation is suspected. At least two position must be taken in this examination, including supine abdominal and erect thorax image or left lateral decubitus. Free air even in small amounts can be detected at plain photo. The patient remains in this position for 5-10 minutes before the photo is taken [5]. Pneumoperitoneum image on plain radiograph can include several signs such as [5]:

a) Cupola / saddlebag / mustache sign seen on supine position radiograph. Cupola's Sign refers to the accumulation of air below the central tendons of the diaphragm.

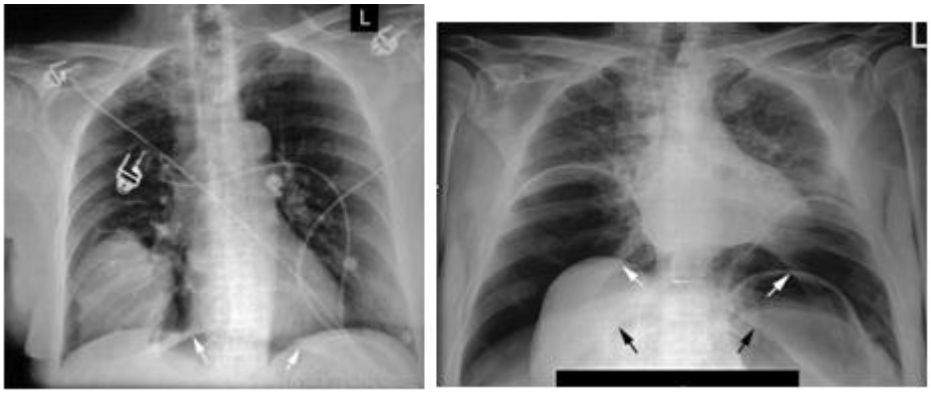

Figure 3: The cupola's sign (white arrow) and the lesser sac gas sign (black arrow)

b) Gas-relief's sign or Rigler's sign or Double Wall's sign. Rigler's sign is a sign of pneumoperitoneum as seen on the abdominal radiograph when the air in the intestinal lumen and the air in in the peritoneal cavity flanks the intestinal wall from two sides. This sign is seen in massive pneumoperitoneum (> 1000 mL).

Figure 4: Rigler Sign

Figure 5: Football Sign

c) Signs of lucent liver, namely reduced opacity in the liver due to the location of free air in anterior side of the liver
d) Foot-ball sign seen in massive pneumoperitoneum where "the abdominal cavity is limited by gas".

Figure 6: Telltale Triangle Sign

Figure 7: Urachus Sign

e) Silver sign, also called ligamentum falciforme sign.
f) Inverted V sign is an air line separating the lateral umbilical ligament (inferior epigastric vessel) containing the epigastric vessel inferiorly in the pelvic area as a result of a massive pneumoperitoneum.
g) Doge's cap, which is a triangular gas accumulation in the morison bag.
h) The telltale triangle sign is a picture of a triangular air pocket between the three layers of the intestine. The telltale triangle sign represents a triangular area formed due to the presence of air between two intestinal lumens and the abdominal wall.[5],[6]
i) The sign of Urachus is an outline of the middle umbilical ligament. [2] The urachus sign is a vestigial peritoneal reflection that is usually not visible on plain abdominal radiograph.
j) The peritoneal sign on plain radiographs is classified as minimal pneumoperitoneum and massive pneumoperitoneum. If there are more than 1000 mL of free air in the peritoneal cavity, it is called massive pneumoperitoneum. The imaging signs of massive pneumoperitoneum such as: [6], [7]
   - Football's sign,
   - Gas-Relief's sign or Rigler's sign or Double Wall's sign,
   - Urachus sign,
   - Lateral umbilical ligament containing blood vessels of the inferior epigastric vessel can be seen as an inverted 'V',
   - Scrotal air can be seen due to peritoneal intrascrotal extension (via a patented processus vaginalis),
   - Cupola's sign refers to the accumulation of air under the central tendons of the diaphragm,
   - Telltale triangle sign.

CT-scan is the standard examination for detecting pneumoperitoneum which more sensitive than plain abdominal radiographs, but it is not always needed in a case if pneumoperitoneum is suspected because its cost and also its larger radiation effect. CT-scan is useful for identifying intraluminal air in minimal numbers, especially when plain abdominal radiograph findings are not specific. [4]

Another drawback, it is difficult to localize the perforation by CT-scan, because of the existence of free air in the peritoneum is a nonspecific finding to determine the etiology of pneumoperitoneum itself. The cause of the perforation can sometimes be diagnosed with a CT-scan. On a CT scan, oral contrast is used to opacity the lumen in digestive tract and help to show the origin of perforation [8].

On magnetic resonance imaging (MRI), the pneumoperitoneum can be seen as an area with hypointense features in all sections. Pneumoperitoneum can accidentally found on MRI because MRI is not the first line imaging modality. The presence of bowel peristalsis can obscure

imaging of the abdomen [7].

On ultrasound imaging, pneumoperitoneum appears as an increase of ecogenicity in linear regions with reverberation artifacts or Distal Ring Down. Air accumulation localized due to intestinal perforation can be detected, especially if it adjacents to other abnormalities, such as thickening of the intestinal wall. Compared to plain photos of abdomen, ultrasound has an advantage in detecting other abnormalities, such as intraabdominal free fluid and inflammatory masses. Ultrasound is available in most health care services and its cost also cheaper than CT-scan, and it is safe especially in patients who have problems or contraindicated to be exposed with radiation such as children, pregnant women, and people in reproductive age. [8]

In this case, patient's chest X-ray showed a cupola / saddlebag / mustache sign (sign white arrows) (fig 1) and plain radiograph showed ligamentous falciforme sign (white arrow), Rigler sign (blue arrow) and tellate triangle sign (arrowhead white) (image 2). The sign of cupola / saddlebag/ mustache refers to the accumulation of air in below the central tendon of the diaphragm. [8]

6. Conclusion

The diagnosis of the patient is based on the history, physical examination, and complementary examination in the form of chest X-rays and plain abdominal radiograph with an erect position [1]. Although left lateral decubitus (LLD) images were not performed, images on the chest X-rays and plain abdominal radiograph in erect position are quite clear to show the presence of large amount of free air in a massive pneumoperitoneum. Gastric perforation was suspected as the cause of pneumoperitoneum in this patient due to the patient's age and history of pain medication for his chronic gastritis. To determine the etiology also the definitive treatment for pneumoperitoneum in this patient, laparotomy procedure or other operative technique was performed with the consideration of a digestive surgeon as pneumoperitoneum is a medical emergency due to the presence of free air in the peritoneal cavity [1]. Because there is no digestive surgeon and adequate operating facilities at Bangli Hospital, the patient was referred to Sanglah General Hospital for further treatment.

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