Pneumoperitoneum: What Does Free Air Under the Diaphragm Really Mean in the Older Adult?

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The following is a response by Carol L. Howe, MD, MLS, on August 6, 2007 to this question submitted by James Warneke, MD, Associate Professor of Surgery and Director, General Surgery Residency Program, University of Arizona College of Medicine. This series is part of the Arizona Reynolds Program of Applied Geriatrics at the University of Arizona established through a grant from the Donald W. Reynolds Foundation.

Does the presence of free air under the diaphragm on a chest or abdominal x-ray always indicate the need for emergency surgery in an elderly person?

One of the literature addressing the issue of free air under the diaphragm, or pneumoperitoneum, (PP) is elderly-specific. Differentiation is made, however, between neonatal, pediatric, and adult patients. Much of the literature is based on case reports and studies of relatively small numbers of patients. An excellent overall review is Mularski, Sippel and Osborne’s 2000 article in Critical Care Medicine, “Pneumoperitoneum: A review of nonsurgical causes.”

Most cases of free air under the diaphragm are indeed a result of a perforated viscus and thus surgical emergencies. Approximately 10% of pneumoperitoneum cases, however, are non-surgical. According to Mularski et al.: “Nonsurgical pneumoperitoneum is defined by the presence of air in the peritoneal space that is detectable by roentgenogram and either is managed successfully by observation and supportive care alone or results in a nondiagnostic laparotomy.” Other terms for nonsurgical pneumoperitoneum, or for subsets of nonsurgical pneumoperitoneum are: spontaneous PP, aseptic spontaneous PP, benign PP, idiopathic PP, asymptomatic PP, spontaneous asymptomatic PP, misleading PP, and pneumoperitoneum without peritonitis.

To ascertain the acuity of a visualized pneumoperitoneum, a physician must first insure that the radiological finding is real and not a “pseudopneumoperitoneum.” If what appears to be air under the diaphragm fails to shift when the patient is positioned differently or if “the radiolucency [fails] to collect in the most superior possible position,” the likelihood is low that a true pneumoperitoneum exists.

The second key step in evaluating a pneumoperitoneum is the history and physical. A pneumoperitoneum in the absence of abdominal pain, distension, fever, leukocytosis or peritoneal signs such as guarding and rebound tenderness, for example, may be suggestive of a non-surgical cause and may warrant conservative management with close monitoring. A familiarity with the most common etiologies for nonsurgical pneumoperitoneum is vital when gauging the urgency of taking a patient with free air under the diaphragm to the operating room for an exploratory laparotomy.

Many authors classify pneumoperitoneum according to its etiology: abdominal, thoracic, gynecological, and idiopathic or other. Continuous ambulatory peritoneal dialysis (CAPD) is another abdominal cause of PP. In one retrospective study of 101 CAPD patients, 33.6% had at least one instance of PP. Of these 38.2% were felt to result from catherter implantation, 29.5% as a result of peritonitis and 32.4% for reasons that remained undetermined. Two of the 34 patients (5.8%) had PP and peritonitis as a result of a perforated viscus. The pneumoperitoneum associated with CAPD is often asymptomatic and felt to be a result of poor technique when doing the exchanges.

Placement of percutaneous endoscopic gastrostomy (PEG) tubes is a third common cause of PP. Mularski et al. estimate that approximately 25% of such procedures result in PP. Most cases resolve within one week, though close monitoring is advocated.

Pneumoperitoneum can also occur as a result of colonoscopy, though this is much less frequent. Polypectomy can occasionally cause transmural burns of the colon (“post-polypectomy syndrome”), leading, in turn to pneumoperitoneum. Mularski et al. (1999) and Mularski et al. (2000) state that these cases should be managed conservatively even in the presence of minor peritoneal signs.

Although some authors list Pneumatosis cystoides intestinalis (PCI) as an idiopathic cause of pneumoperitoneum, others consider it to be the most common abdominal etiology for PP after laparotomy and laparoscopy. PCI is characterized by multiple intramural gas-filled cysts in any portion of the gastrointestinal tract but is most commonly found at the terminal ileum. Rupture of these submucosal and subserosal cysts causes pneumoperitoneum. PCI usually is found in conjunction with other primary diseases including collagen vascular diseases, bone marrow transplantation, malignancy, inflammatory bowel disease, acquired immunodeficiency syndrome, and others.

Thoracic:

Mularski et al. note that prevalence rates of thoracic causes of nonsurgical PP are not established, as they are for abdominal causes. They list mechanical ventilation—especially when high pressures are needed—, cardiopulmonary resuscitation, and pneumothorax as the most common thoracic causes with rarer case reports of tracheal rupture, median sternotomy and blast injury as other causes. Chronic obstructive pulmonary disease resulting in pleural tears is also mentioned as a cause by Hoover et al. Rowe, Kahn, Acinapura and Cunningham further elaborate and list other causes:

Barotrauma represents the most frequent intrathoracic cause of NP. Severe pulmonary disease, such as cavitary tuberculosis, pneumonia, bullous emphysema, asthma, and bronchopneumonic fistulas, as well as sport diving, also have been implicated as causes of NP. Once a pneumothorax is diagnosed, appropriate chest tubes should be placed. If the thorax is the source of the PP, then resolution of the PP should ensue. A helpful clue to the etiology of the PP as being from above the diaphragm is an abdominal X-ray showing air in the paraspinal area of the
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retroperitoneum. Remember, this source of PP has been documented in all age groups, from neonates to the very old. 5

Hoover, Cole. Mitchell, Adams and Hassett et al. note that the mechanism in thoracic cases is probably air from ruptured alveoli traveling along mediastinal vessel sheaths into the retroperitoneum and finally into the abdominal cavity. 5 In those situations in which air enters the abdomen through a diaphragmatic defect, an unusually large collection of air may accumulate under the diaphragm an “observation [which] alone should alert the clinician to the possibility of a nonsurgical pneumoperitoneum.” 5(p. 102)

Gynecological:

In females, air can also travel through the vagina, uterus and fallopian tubes to enter the peritoneal cavity. This can occur through orogenous sex, douching, post-partum knee-chest exercises, tubal insufflation during a hysterosalpingogram, and as a result of pelvic inflammatory disease. Anatomical abnormalities may predispose to transfer of air in this way although this is controversial. Pregnancy is also known to lower the threshold for air transfer via the urogenital tract.1, 2, 4, 5 Management should be watchful waiting and obtaining genital cultures for gas forming organisms.6 Gynecological causes are rare overall and, by their very nature, even more rare within the geriatric population.

Miscellaneous, Idiopathic and Other:

Occasionally no definitive source is identified for the air seen under the diaphragm of a patient with pneumoperitoneum. Listed among those conditions with which pneumoperitoneum can occasionally be associated are: lymphoma and scleroderma1, 8 other collagen vascular diseases, cocaine use,1 diving with decompression1, 2, 9 and dental extraction1

Other diagnostic tests:

In cases where a pneumoperitoneum exists and its acuity in terms of whether or not it represents a perforated viscus remains uncertain, several authors advocate doing a few other diagnostic procedures such as paracentesis; diagnostic peritoneal lavage (DPL); DPL with instillation of methylene blue through an NG tube; serial abdominal x-rays following instillation of water-soluble contrast material via NG tube or rectally; and or/ upper and lower endoscopies. 1, 2, 10

Conclusion:

Pneumoperitoneum is indicative of a perforated viscus in the majority of cases. In approximately 10% of cases, however, its etiology is due to another cause as outlined above, and surgery has the potential to be avoided. By carefully coordinating history, physical, radiographic confirmation and occasionally additional studies, physicians may be able to accurately identify the small subset of patients with benign or nonsurgical pneumoperitoneum. In then advocating careful observation and monitoring rather than emergency (unnecessary) surgery, potentially significant morbidity and even mortality in patients who may already be seriously compromised, can be safely avoided. This has particular relevance for the frail elderly population.

References