

## Postoperative pneumoperitoneum after colorectal surgery: Expectant vs surgical management

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**Author contributions:** Spinelli N and Frattini JC contributed equally to this work; Spinelli N and Frattini JC performed the research; Nfonam V, Marcet J and Velanovich V analyzed the data; Spinelli N and Frattini JC wrote the paper.

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Received: June 19, 2011 Revised: June 18, 2012

Accepted: June 23, 2012

Published online: June 27, 2012

### Abstract

Postoperative pneumoperitoneum poses a clinical dilemma. Depending on the cause, its management includes a spectrum from simple observation and supportive care to surgical exploration. The aim of this paper is to present four clinical cases and propose an algorithm for the management of postoperative pneumoperitoneum based on available literature. The causes, diagnosis and possible complications arising from pneumoperitoneum will also be discussed. Three of the four cases presented were successfully managed conservatively and one had an exploratory laparotomy with negative findings. In such scenarios, it is important to consider the non-surgical causes of pneumoperitoneum, which include pseudopneumoperitoneum, thoracic, abdominal, gynecological and idiopathic. These causes do not always require emergent exploratory laparotomy. The surgical team needs to consider the history, physical exam and diagnostic workup of the patient. If a patient presents with peritoneal signs, then exploratory laparotomy is a must. Since 10% of the cases of pneumoperitoneum are caused by nonsurgical entities, managed expectant-

ly, a negative exploratory laparotomy and its associated risks are avoided.

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**Key words:** Postoperative pneumoperitoneum; Free air under diaphragm; Colorectal surgery; Benign pneumoperitoneum; Spontaneous pneumoperitoneum

**Peer reviewer:** Tsuyoshi Konishi, MD, PhD, Department of Gastroenterological Surgery, Cancer Institute Hospital, 3-10-6 Ariake, Koto-ku, Tokyo 135-8550, Japan

Spinelli N, Nfonam V, Marcet J, Velanovich V, Frattini JC. Postoperative pneumoperitoneum after colorectal surgery: Expectant vs surgical management. *World J Gastrointest Surg* 2012; 4(6): 152-156 Available from: URL: <http://www.wjgnet.com/1948-9366/full/v4/i6/152.htm> DOI: <http://dx.doi.org/10.4240/wjgs.v4.i6.152>

### INTRODUCTION

Postoperative pneumoperitoneum, or free air in the peritoneal cavity after surgery, can be seen as a radiolucency on radiographs. It localizes under the diaphragm, where the pressure is negative compared to the rest of the peritoneal cavity, and can be found there regardless of position of patient<sup>[1]</sup>. Free air after a major abdominal procedure poses a clinical dilemma. Is the retained free air from the operation or does this indicate a perforated viscus or possible postoperative complication? Clearly, these have different forms of management; the former one is observation while the latter requires re-exploration. It is well established that pneumoperitoneum with fever, abdominal tenderness or distension, leukocytosis or signs of peritoneal irritation is a surgical emergency<sup>[2-4]</sup>. Free air postoperatively can indicate visceral perforation, anastomotic leak or a ruptured pericolic abscess<sup>[1]</sup>. In the majority of cases of pneumoperitoneum there is visceral

perforation. Only 5% to 15% of the time, the cause of free air is something other than a perforation and does not require surgery<sup>[5-7]</sup>. This is called “nonsurgical<sup>[4,8,9]</sup>”, “spontaneous<sup>[2,10-13]</sup>” or “misleading<sup>[14]</sup>” pneumoperitoneum. This is a condition in which imaging shows free air in the peritoneal cavity that can either be managed with observation and supportive care alone or results in a negative laparotomy<sup>[4,12]</sup>.

The aim of this paper is to present four clinical cases seen in our colorectal practice and discuss the causes, diagnosis, management and possible complications of pneumoperitoneum.

## CASE REPORT

### Case 1

The patient, a 63-year-old male, with a height of 177.8 cm, weight of 77.6 kg and BMI 24.6, underwent an ileostomy reversal status post restorative proctocolectomy with creation of ileoanal J-pouch and diverting ileostomy secondary to rectal and colonic polyps. On postoperative day 6, he began having episodes of emesis. His abdominal exam was unremarkable, without signs of an acute abdomen. The next day, the emesis continued and an acute abdominal series was obtained, showing free air. Patient was made NPO, intravenous fluids were given and a nasogastric tube was placed. He remained afebrile without leukocytosis and a normal abdominal exam. The patient was monitored clinically with serial abdominal exams. Eventually, his ileus resolved, his diet was slowly advanced and he was discharged from the hospital without requiring re-exploration.

### Case 2

The patient, a 45-year-old female, with a height of 172.7 cm, weight of 63.1 kg and BMI 21.2, status post laparoscopic subtotal colectomy with end-to-side ileorectal anastomosis, sacrocolpopexy and rectopexy for colonic inertia and pelvic floor dysfunction, presented to the emergency department on postoperative day 7 with progressively worsening abdominal pain, nausea, vomiting and an inability to urinate. On clinical exam, she had incisional tenderness and an X-ray showed free air. She had no leukocytosis and was afebrile. She was taken to the operating room for exploratory laparotomy, which resulted in negative findings. She eventually was discharged home after tolerating a diet.

### Case 3

The patient, a 66-year-old male, with a height of 170.2 cm, weight of 65.1 kg and BMI 22.5, had ulcerative colitis status post laparoscopic restorative proctocolectomy with ileoanal J-pouch and diverting loop ileostomy, developed nausea and emesis on postoperative day 3 without peritoneal signs. He had a leukocytosis but remained afebrile. Abdominal series showed free air and continued distended loops of bowel with mucosal thickening. A nasogastric tube was placed, he was made NPO, given IV

fluids and started on antibiotics. He was followed clinically and on postoperative day 6, he continued to have nausea and a high nasogastric tube output. A computed tomography (CT) of abdomen and pelvis was obtained and demonstrated a moderate amount of free intraperitoneal air, as well as diffuse dilation of the small bowel without transition point likely to represent ileus. In the following days, the patient's clinical symptoms improved, white blood cell count trended down to a normal value and the nasogastric tube was removed, he tolerated a diet and was discharged home.

### Case 4

The patient, a 44-year-old male, with a height of 172.7 cm, weight of 75.8 kg and BMI 25.4, underwent the creation of an end ileostomy to palliate an enterovesicular fistula that developed after undergoing an ileal pouch anal anastomosis for ulcerative colitis. He presented 8 d postoperatively with a wound infection. The abdominal X-ray demonstrated no free air but the CT scan performed 3 h later did. The white blood cell count was 11.5 and he was without peritoneal signs. He was discharged home 2 d later, without exploration, tolerating a diet.

## DISCUSSION

These vignettes serve as examples of the management of postoperative pneumoperitoneum in relationship to the clinical history, physical exam and diagnostic workup. Two of our patients had ulcerative colitis, a form of inflammatory bowel disease. Could these patients be at a higher risk of developing postoperative pneumoperitoneum? No study answers this question directly; however, it has been shown that patients with inflammatory bowel disease are at a higher risk of postoperative complications<sup>[15,16]</sup>. One of the possible complications is anastomotic leaks, which in turn, has been shown to be a cause of postoperative pneumoperitoneum<sup>[1,15,16]</sup>. These patients are at a higher risk for leaks due to their immunosuppressed state and overall inflammatory disease process causing tissue friability and dense adhesions<sup>[16]</sup>. In the year 2000, Hamel *et al.*<sup>[16]</sup> compared ileocolic vs. subtotal colectomy for inflammatory bowel disease and found that the overall postoperative complication rate was not significantly different between the two groups. However, their study had a small sample size of 109 patients<sup>[16]</sup>. In 2011, Cotte *et al.*<sup>[15]</sup> compared inflammatory bowel disease to other indications of total colectomy and found significantly more anastomotic leaks in the former patients. In addition, in patients receiving total colectomy for other indications other than inflammatory bowel disease, such as colon cancer, slow transit constipation or diverticular disease, the anastomotic leak rate was equivalent to segmental colectomy<sup>[15,17]</sup>. Thus, because the rate of leaks between total and segmental colectomy for conditions other than inflammatory bowel disease is similar, it can be inferred that the rate of postoperative pneumoperitoneum is not increased because of the procedure but is related

**Table 1 Pathophysiological mechanisms for some of the causes of nonsurgical pneumoperitoneum**<sup>[2,4,19,20,22,23]</sup>

Nonsurgical causes	Pathophysiological mechanism
Pseudopneumoperitoneum	Adventitial air shadows Overdistension of hollow viscera Undulant configuration of the diaphragm Gas trapped in established wounds Basal pulmonary atelectasis Subdiaphragmatic extraperitoneal fat Interposition of the hepatic flexure of colon between right lobe of liver and diaphragm
Thoracic	Mechanical ventilation High airway pressures Large tidal volumes Noncompliant lungs Preexistent pulmonary disease Cardiopulmonary resuscitation Pneumothorax Pneumomediastinum Rapid decompression (diving accidents) Tracheal rupture Median sternotomy Blast injury
Abdominal	Postoperative retained air after abdominal surgery Peritoneal dialysis Percutaneous endoscopic gastrostomy Endoscopic procedures Pneumatosis cystoides intestinalis Blunt abdominal trauma
Gynecological	Vaginal insufflations Pelvic inflammatory disease Post partum knee chest exercises Coitus Gynecological exams Vaginal douching
Idiopathic	

to the underlying disease process. Interestingly, the two patients in this series with ulcerative colitis did not have an anastomotic leak and were managed conservatively.

The causes of pneumoperitoneum can be surgical or nonsurgical. There are five main nonsurgical causes of free air in the peritoneal cavity. These are categorized as follow: pseudopneumoperitoneum, thoracic, abdominal, gynecological and idiopathic<sup>[3,8,18-22]</sup>. Table 1 lists the pathophysiological mechanisms for causes of nonsurgical pneumoperitoneum<sup>[2,4,19,20,22,23]</sup>.

Pseudopneumoperitoneum is described as the simulated roentgenographic appearance of free intraperitoneal air<sup>[18,20]</sup>. Features that can be used to discriminate this from true free peritoneal air include failure of air to shift location with different radiographic positioning and failure of radiolucency to collect in the most superior possible position<sup>[14]</sup>. Some causes of pseudopneumoperitoneum can occur with adventitial air shadows, overdistension of hollow viscera and basal pulmonary atelectasis simulating subphrenic air<sup>[14,24]</sup>. In the year 2000, Mularski *et al*<sup>[20]</sup> performed a systematic review of the literature from 1970 to 1999, using MEDLINE Medical Literature Database, to find the prevalence of nonsurgical causes of pneumoperitoneum. Few thoracic causes exist and in adults the most frequent are mechanical ventilation, cardiopulmonary resuscitation and pneumothorax. For abdominal causes, the most frequently encountered are

abdominal surgery, peritoneal dialysis and endoscopic procedures<sup>[20]</sup>. Free air after an abdominal procedure is common; it occurs in 60% of laparotomies and 25% of laparoscopic procedures. Reabsorption of free air is expected with time<sup>[20]</sup>. Two-thirds of cases resolve within 2 d and 97% of cases resolve within 5 d<sup>[25]</sup>. Lean adults have a more prolonged postoperative pneumoperitoneum than overweight patients because the bulky panniculus in obese adults restricts the distension of the peritoneal space and thus limits the volume of air collected initially<sup>[24]</sup>. The most common abdominal cause that is not procedure related is pneumatosis cystoides intestinalis; a condition where multiple intramural gas-filled cysts are found in any portion of the gastrointestinal tract. If these cysts rupture, then pneumoperitoneum can result. The cause can be idiopathic or can be associated with other diseases such as bone marrow transplantation, collagen vascular disease, malignancy, inflammatory bowel disease and others. It resolves spontaneously with conservative management<sup>[2,4,20,26]</sup>. The gynecological causes occur anytime air is introduced *via* the genital tract into the peritoneal cavity; most common causes include pelvic manipulation or insufflation<sup>[20]</sup>. For idiopathic causes, it has been suggested that there could be a subclinical perforation that resolves without surgery or other unidentified processes<sup>[20]</sup>.

Pneumoperitoneum can be detected during clinical exam by abdominal percussion or by imaging. CT scan is

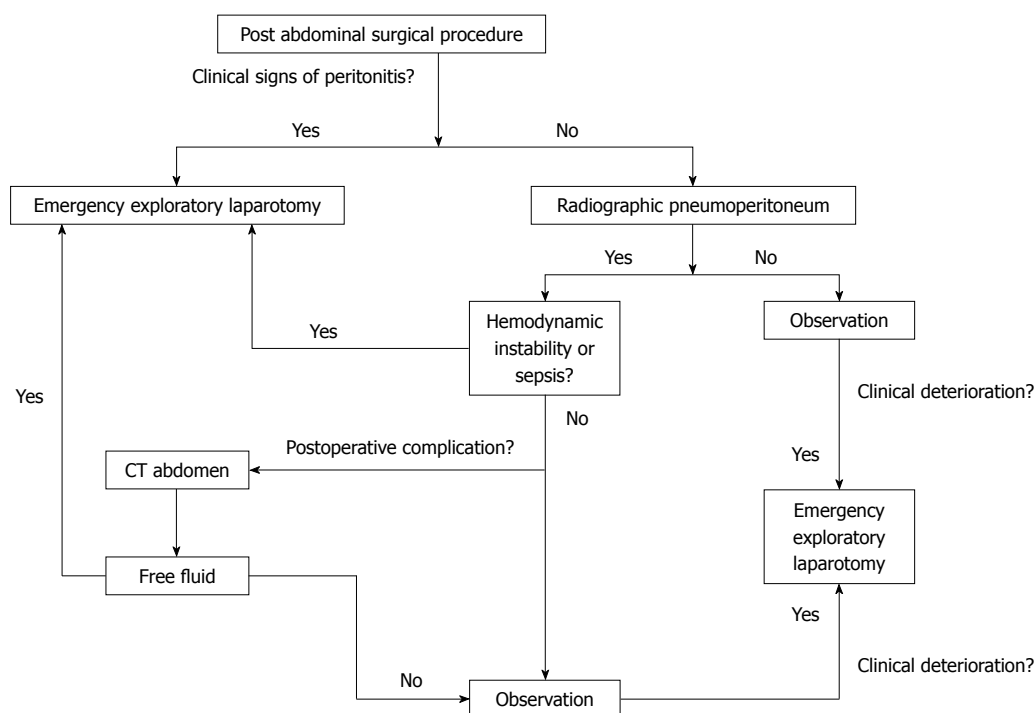


Figure 1 Proposed management of postoperative pneumoperitoneum<sup>[3,4,9,18,20-23,29,31]</sup>. CT: Computed tomography.

more sensitive than plain radiographs, both upright chest and lateral decubitus position, in detecting free air; in addition, CT scans showed no correlation between body habitus and the amount of free air<sup>[27,28]</sup>. If patients are suspected of having a ruptured viscus, a water-soluble contrast should be used. After the iodinated contrast material is given by mouth, nasogastric tube or enema, a CT scan or a right anterior oblique film of the abdomen should be obtained<sup>[22,24]</sup>.

The literature shows that nonsurgical pneumoperitoneum should be managed conservatively when no signs of peritonitis are encountered<sup>[2,4,8,9,12,19-21,29,30]</sup>. Unfortunately, there has not been a guideline or algorithm developed based on a clinical trial for postoperative pneumoperitoneum. With regards to management of free air postoperatively, we propose the following: if after an abdominal procedure, a patient develops signs of peritonitis, this patient needs emergent re-exploration<sup>[2-4,9,12,20,21,23]</sup>. Cues aiding the decision to explore include abdominal tenderness or distension, leukocytosis, fever or peritoneal irritation. If no signs of peritonitis are seen but there is radiographic evidence of pneumoperitoneum and hemodynamic instability or sepsis, the patient needs surgical exploration. If there is radiographic evidence of pneumoperitoneum but no peritonitis and no hemodynamic instability or sepsis, the patient can be observed with repetitive clinical exams and supportive care<sup>[9,18]</sup>. In this case, nonsurgical causes of pneumoperitoneum should be considered<sup>[2-4,7-9,18-22]</sup>. Failure of conservative management should prompt exploration<sup>[9]</sup>. In the case where there is radiographic pneumoperitoneum and no hemodynamic instability or sepsis but a postoperative complication is suspected, then abdominal computed tomography is sug-

gested. If this abdominal CT shows free fluid, then the patient should be considered for exploration based on clinical judgment. It has been suggested that if the assessment for peritonitis is equivocal, then a peritoneal tap and lavage can be useful; if the fluid recovered is normal then continue clinical observation<sup>[3,9,18,19,23,29-31]</sup>. Figure 1 shows management of postoperative pneumoperitoneum as a flowchart based on the literature<sup>[3,4,9,18,20-23,29,31]</sup>.

In 1961, Bevan<sup>[1]</sup> listed the complications arising from postoperative pneumoperitoneum as: (1) postoperative pain in same shoulder of unilateral pneumoperitoneum, presumably due to diaphragmatic stretching by air below; (2) basal pulmonary collapse; (3) dehiscence of the surgical incision; (4) subphrenic abscess due to air opening up spaces where intra-abdominal infection can spread; (5) phlebotrombosis and pulmonary embolism due to increased abdominal pressure preventing venous return to heart leading to lower extremity venous stasis; and (6) delayed restoration in gastro-intestinal function.

It is of uttermost importance to raise awareness of management of postoperative pneumoperitoneum, along with its clinical and medicolegal implications. Further research should focus on prospective studies for the management of free air and should include a multidisciplinary team composed of surgeons and radiologists. Without a doubt, if a clinical exam suggests peritoneal irritation with laboratory and imaging supporting pneumoperitoneum, surgical exploration is a must. It is important to recognize nonsurgical pneumoperitoneum and remember its association with pseudopneumoperitoneum, intrathoracic, intra-abdominal, gynecological and idiopathic causes. If the clinical history suggests postoperative retained air or nonsurgical causes, then conservative management

with frequent clinical evaluations should be considered to avoid the risks and financial burden of a negative exploratory laparotomy.

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S- Editor Wang JL L- Editor Roemmele A E- Editor Zheng XM