

# Conservative management for spontaneous pneumoperitoneum

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## ABSTRACT

**Introduction:** To improve and standardize care of patients who present with spontaneous pneumoperitoneum in order to decrease morbidity and mortality due to non-therapeutic laparotomy or laparoscopy. **Case Series:** A retrospective case series was conducted at University of Pittsburgh Medical Center (UPMC) Horizon from April 2011 to September 2016. Hospital EHR was searched to identify patient records containing ICD-9/10 codes for pneumoperitoneum. All charts were then examined and any cases with an identifiable etiology for the pneumoperitoneum (perforated peptic ulcer disease or perforated diverticulitis) were excluded. A total of five cases of spontaneous pneumoperitoneum were identified at UPMC Horizon during the allotted time period. Mean age at 55.4 with four male and one female patient. Four patients were managed non-operatively with empiric antibiotics, bowel rest and serial abdominal exams. One patient was taken to the operating room for non-therapeutic laparotomy. All five patients were discharged from the hospital in stable condition. **Conclusion:** Perforated viscous requiring emergent surgical intervention is the most common cause of pneumoperitoneum. There are numerous other causes of pneumoperitoneum

that must always be kept in the differential diagnosis. Patients with pneumoperitoneum who demonstrate hemodynamic instability, peritonitis, leukocytosis, identifiable hollow viscous source on cross sectional imaging or meet SIRS criteria should urgently undergo exploration. Patients that do not meet these criteria may be safely observed. Our case series demonstrates that some of these patients may safely be treated non-operatively and be spared the morbidity and mortality of exploration.

**Keywords:** Non-operative, Pneumoperitoneum, Pneumatosis

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## INTRODUCTION

Spontaneous pneumoperitoneum presents a therapeutic dilemma for the general surgeon. Pneumoperitoneum is defined a free intraperitoneal air which is outside the gastrointestinal tract. Spontaneous pneumoperitoneum refers to the presence of free intraperitoneal air without an identified attributing event or pathology. Although the majority of patients who present with free air in the abdomen require emergent

surgical intervention due to a perforated viscus, in up to 10 percent of cases, the extra peritoneal air is from another source [1] and non-operative management can be safely attempted in carefully selected patients. The general surgery department at UPMC Horizon encountered five patients over the last five years who presented with pneumoperitoneum without clinically apparent etiology.

## CASE SERIES

A retrospective case series was conducted at UPMC Horizon from April 2011 to September 2016. Hospital EHR was searched to identify patient records containing ICD-9/10 codes for pneumoperitoneum. All charts were then examined and any cases with an identifiable etiology for the pneumoperitoneum (perforated peptic ulcer disease or perforated diverticulitis) were excluded. Any patients who presented with peritonitis, hemodynamic instability, acidosis or evidence of systemic inflammatory response were also excluded. A total of 31 cases of pneumoperitoneum were discovered, however 26 were excluded, so five patients were identified that met the inclusion criteria over the five year period examined. Imaging from these cases is not available in our PACs system.

### Case 1

Patient is a 45-year-old male who was admitted to the hospital complaining of left-sided chest pain that radiated to the left neck and face. The patient underwent a cardiac work up including a stress test which was negative for a cardiac source. He also complained of a long history of left sided abdominal pain with associated loose bowel movements. The symptoms had reportedly worsened over the three weeks leading up to admission. He also stated that he underwent a diagnostic laparoscopy approximately 10 years prior for similar complaints, but it was non-diagnostic. The patient was normothermic and hemodynamically stable. On physical exam his abdomen was soft, non-distended, and had normal bowel sounds. He had minimal tenderness to palpation of the left side of his abdomen with no evidence of peritonitis. He had no leukocytosis or leukopenia. These complaints prompted a CT scan of the abdomen and pelvis which demonstrated free intra-abdominal air in the left upper quadrant under the left hemidiaphragm and near the splenic flexure of the colon. There was no evidence of inflammation or colonic wall thickening on cross sectional imaging. Conservative treatment was started, nothing by mouth, fluid resuscitation, serial abdominal exams, and initiated intravenous antibiotics in the form of ciprofloxacin and metronidazole. Over the coming days, his abdomen remained benign, and he had no leukocytosis. His diet was slowly advanced as tolerated. He underwent a repeat CT which noted improvement in the pneumoperitoneum, but incomplete resolution. The patient was discharged home

to complete a 14 day course of antibiotics. He underwent a repeat CT as an outpatient, which revealed complete resolution of the pneumoperitoneum. The patient also underwent a colonoscopy as an outpatient, and he was noted to have some diverticulosis, but otherwise a normal colon; with special attention to his splenic flexure, he was noted to have no abnormality. This region was biopsied nonetheless, results revealed the region to be negative for neoplasia, but it was positive for focal mild nonspecific chronic inflammation.

### Case 2

Patient is a 74-year-old female who presented to the emergency department with a 4 day history of abdominal pain. The pain was localized to her umbilicus and did not radiate. She had no associated symptoms and was tolerating a diet without difficulty. The patient was normothermic, and hemodynamically stable. On physical exam, the patient's abdomen was noted to be soft, non-distended, with normal bowel sounds, very mild diffuse tenderness to palpation, with no peritoneal signs. She had no leukocytosis or leukopenia. She underwent a CT scan of the abdomen and pelvis which showed diffusely scattered free air. The CT also showed a small non-obstructing ventral hernia containing small bowel, colonic diverticulosis without diverticulitis, a small hiatal hernia, and a 4.1 cm infrarenal abdominal aortic aneurysm. There was no identifiable cause of the pneumoperitoneum on CT. Operative exploration was offered to the patient's power of attorney, however, the power of attorney declined surgical intervention for the patient and elected non-operative management. She was treated with intravenous antibiotics, bowel rest and fluid resuscitation. Subsequent imaging revealed resolution of the pneumoperitoneum. Patient was discharged back to nursing home in stable condition.

### Case 3

A 30-year-old male who presented to the emergency department with three day history of abdominal pain associated with non-bilious, non-bloody emesis. He noted having similar symptoms the month before and they were self-limiting. He denied melena, hematochezia, weight loss, fever, chills or urinary complaints. The patient was normothermic, and hemodynamically stable. On physical exam, the patient's abdomen was noted to be soft, obese, non-tender with mild distention. There was no rebound tenderness, guarding, or rigidity appreciated. He had no leukocytosis or leukopenia. CT imaging of the abdomen and pelvis was performed which demonstrated a large amount of free air in the peritoneal cavity without obvious perforated viscus. He was taken emergently to the operating room for exploratory laparotomy. The decision was made for exploration due to the concern for bowel ischemia on cross sectional imaging. He was found to have extensive pneumatosis throughout his omentum

as well as the proximal ascending colon to the distal transverse colon. There was also a significant amount of bowel wall thickening of the transverse colon. There was no evidence of ischemia, necrosis or perforation. He also had significant stool burden in his colon. The patient's abdomen was left open and he was taken back to the operating room for a planned second look laparotomy 24 hours later. On second exploration there was minimal improvement of the prior pneumatosis still with no ischemia, necrosis or perforation. An incidental appendectomy was performed and the abdomen was closed. Patient was given a bowel regiment and his diet was advanced as tolerated. He was given five total days of intravenous antibiotics. He was discharged home in stable condition.

#### Case 4

Patient is a 49-year-old male who presented to the emergency department complaining of two weeks of bilateral shoulder pain. Patient denied any recent trauma, surgery, or procedure. The patient was normothermic, and hemodynamically stable. On physical exam, his abdomen was noted to be softly distended with mild tenderness to palpation in upper quadrants bilaterally. Complete blood count showed normal white blood cell count with a normal differential. Chest X-ray showed free air under the right hemidiaphragm. A follow-up CT of the abdomen and pelvis was ordered to attempt to localize the perforation, which showed free intraperitoneal air without evidence of inflammation. Due to the patient's lack of clinical symptoms and benign abdominal it was elected to observe the patient cautiously and treat him conservatively. The patient was made nothing by mouth, fluid resuscitated, and monitored closely via serial abdominal examinations. His shoulder pain had completely resolved leaving him symptom-free. Patient's diet was slowly advanced starting with clear liquids for 24 hours, followed by full liquids for 24 hours, and the patient was tolerating a regular diet prior to discharge. Patient was discharged home in stable condition.

#### Case 5

A 79-year-old male who presented to the emergency department with a chief complaint of gross hematuria and dysuria. The patient reported he had these symptoms for the two weeks prior to presentation. He was scheduled to be evaluated by urology for a cystoscopy. The patient reported that he presented to the ER because of worsening dysuria and hematuria and was subsequently evaluated with a CT scan. The patient denied any complaints of fevers, chills, abdominal pain, nausea, vomiting, hematochezia, melena, hematemesis, or any changes in his bowel habits. He underwent a colonoscopy in 2014 and was found to have non-thrombosed external hemorrhoids, diverticulosis, and a polyp in the mid-descending colon, which was biopsied

and pathology was benign. He underwent an upper endoscopy in 2012 and was found to have a small hiatal hernia in addition to gastritis. The patient was noted to be afebrile and hemodynamically stable. On physical exam, the abdomen was noted to be soft, non-tender, and non-distended. He underwent a rectal exam, which revealed external hemorrhoids without evidence of masses. The patient's labs revealed a WBC count of  $7,000^{\text{th}}/\text{mm}^3$  with neutrophils of 78% without bacteremia. Comprehensive metabolic profile, amylase, and lipase were normal. The patient also underwent a urinalysis which was grossly positive for blood, but negative for underlying infection. The patient underwent a CT abdomen and pelvis, which revealed several locules of free air, pneumatosis intestinalis involving the ascending colon, the stomach appeared thickened with no evidence of extravasation of contrast. The patient was admitted to the general surgery service and was managed non-operatively; nothing by mouth, fluid resuscitation, protonix drip, and serial abdominal exams. Conservative management was continued for the next three days, during which time the patient denied any complaints of abdominal pain, remained completely hemodynamically stable, physical exam remained benign, and labs revealed no evidence of a leukocytosis. By hospital day 4, the patient was initiated on a clear liquid diet which he tolerated well and a repeat CT scan was performed, which revealed resolution of the pneumoperitoneum, but the pneumatosis intestinalis appeared grossly unchanged. By hospital day 6, his diet had been advanced to a regular diet and he had met all discharge criteria. He was discharged home in stable condition with planned repeat CT as an outpatient and follow-up with urology for his hematuria. Imaging for these cases was not available in the PACs system.

#### DISCUSSION

The finding of free air on imaging indicates urgent surgical evaluation with the most common cause related to a perforated hollow viscus. Such an injury requires urgent intervention to prevent sepsis and mortality. However, a nonsurgical source is responsible in approximately 10 percent of cases [2]. There are numerous causes of pneumoperitoneum (see Table 1) and these need to be kept in the differential diagnosis during patient evaluation, because many of these causes do not require surgical repair. This case series represents five patients who had radiographic evidence pneumoperitoneum without evidence of hollow viscus perforation. Four patients were treated non-operatively and one underwent a non-therapeutic laparotomy. All patients were discharged from the hospital in stable condition once discharge criteria were met. Pneumatosis intestinalis was identified as the potential source of the free air in two of the five cases. This disease process has a broad differential diagnosis including bowel obstruction, ischemia/necrosis, IBD, neoplasms, enteritis,

Table 1: Causes of spontaneous pneumoperitoneum [1, 2]

Abdominal	
	Post-operative
	Endoscopic procedures
	Post-polypectomy
	Percutaneous endoscopic gastrostomy
	Pneumatosis cystoids intestinalis
	Peritoneal Dialysis
Thoracic	
	Mechanical ventilation
	Pneumothorax
	Bronchoscopy
	Cardiopulmonary resuscitation
	Tuberculosis
	Severe coughing
	Bronchopulmonary fistula
Gynecologic	
	Vaginal insufflation
	Vaginal douching
	Coitus
	Post-partum exercise
	Knee-chest exercise
	Pelvic examination
	Pelvic inflammatory disease
	Jacuzzi use
	Aquatic sports
	Scuba diving

appendicitis, tuberculosis, adhesions, a prior end to end anastomosis, obstructive pulmonary disease, drug-induced, pyloric stenosis, immunosuppression related, trauma, or it may be idiopathic [3–5]. The presentations of patients with pneumatosis intestinalis range from asymptomatic to septic shock. Patients may require surgical intervention or simply observation depending on clinical findings and ultimately the cause of the pneumatosis. It has been suggested that the use of high flow oxygen therapy may be of some utility in improving the resolution of the pneumatosis [6]. This therapy is not without its own risks. Researchers first took note of the damaging effects of oxygen as early as the late nineteenth century. The mechanism of oxygen toxicity is attributed to oxygen-free radicals. These reactive oxygen species have one or more free electrons, making them unstable. These molecules may combine with other species and cause cellular damage. These may directly or indirectly react with lipids, DNA, and proteins, causing cell signaling abnormalities to significant damage in the form of necrosis and apoptosis. Neither of the two cases identified to have pneumatosis in this case series were treated with high flow oxygen therapy [7]. This raises the question, though

there may be a theoretical benefit of high flow oxygen, does it have any clinical benefit or reduce morbidity and mortality. The other three cases in the series had no identified etiology for their pneumoperitoneum. All of these patients were successfully managed non-operatively and discharged from the hospital without adverse event. An interesting pattern that was revealed in this series is that all of these patients were treated with parenteral antibiotics, even though these patients had no evidence of infection. It is doubtful that the addition of antibiotics contributed to the positive outcome in these cases and only contributed antibiotic resistance. This observation will require additional study. There are several limitations to case series. The first being that this represents a small sample size only including five patients. This is due to the uncommon nature of this disease process. Another limitation is that this series is retrospective in nature. A prospective follow-up study would be ideal to test these recommendations.

## CONCLUSION

Perforated viscous requiring emergent surgical intervention is the most common cause of pneumoperitoneum. There are numerous other causes of pneumoperitoneum that must always be kept in the differential diagnosis. Patients with pneumoperitoneum who demonstrate hemodynamic instability, peritonitis, leukocytosis, identifiable hollow viscous source on cross sectional imaging or meet SIRS criteria should urgently undergo exploration. Patients that do not meet these criteria may be safely observed. These observations remain true when pneumatosis intestinalis is identified and high flow oxygen therapy is not required for resolution. These patients are unlikely to benefit from antibiotics if there is no evidence of infection. Based on the experience at UPMC Horizon it is safe to manage carefully selected patients with pneumoperitoneum non-operatively.

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**Author Contributions**

Michael Morrison – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval for publication

Sarah Brown – Acquisition of data, Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Ryan Enders – Acquisition of data, Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Ranjeet Kalsi – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Christopher Esper – Substantial contributions to conception and design, Analysis and interpretation of

data, Revising it critically for important intellectual content, Final approval for publication

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None

**Consent Statement**

Written informed consent was obtained from the patient for publication of this case series.

**Conflict of Interest**

Authors declare no conflict of interest.

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