



## International Journal of Case Reports (ISSN:2572-8776)



### Successful non-operative management of extensive pneumomediastinum and pneumoperitoneum

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#### ABSTRACT

**Background:** A 70 year old male presented with acute left flank pain and was found to have extensive free air in both the mediastinal and peritoneal cavities. He was managed successfully without surgery.

**Case:** A 70 year old male presented with left flank pain that began an hour prior to arrival. He had a history of obstructive sleep apnea that had been treated with continuous positive airway pressure therapy (CPAP) at home for many years. His vital signs, physical exam, and laboratory testing were all unremarkable. However, imaging findings were impressive for massive pneumoperitoneum and pneumomediastinum. Given his clinical stability, operative exploration was deferred, and he was admitted for observation and bowel rest. He was discharged less than 48 hours after admission without incident. His history of home CPAP therapy was the only attributable cause for the ominous findings seen on his imaging. Recognizing that this was a case of benign free air saved this patient from the morbidity and potential for death that comes with an unnecessary operative exploration.

**Conclusion:** Continuous positive airway pressure therapy can result in benign free air within the mediastinal and peritoneal cavities. Evaluating the complete clinical scenario will allow for recognition of similar cases in which these grim findings are not indicative of surgical disease, thus avoiding the iatrogenesis of unnecessary surgery.

**Keywords:** Benign; Pneumomediastinum; Pneumoperitoneum; Primary

#### Abbreviations:

PM: pneumomediastinum, PP: pneumoperitoneum, ED: emergency department, CPAP: continuous positive airway pressure, CT: computed tomography

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#### How to cite this article:

Dylan Johnson, Stephan Jones, Subhasis Misra. Successful non-operative management of extensive pneumomediastinum and pneumoperitoneum. International Journal of Case Reports, 2020; 4:171.

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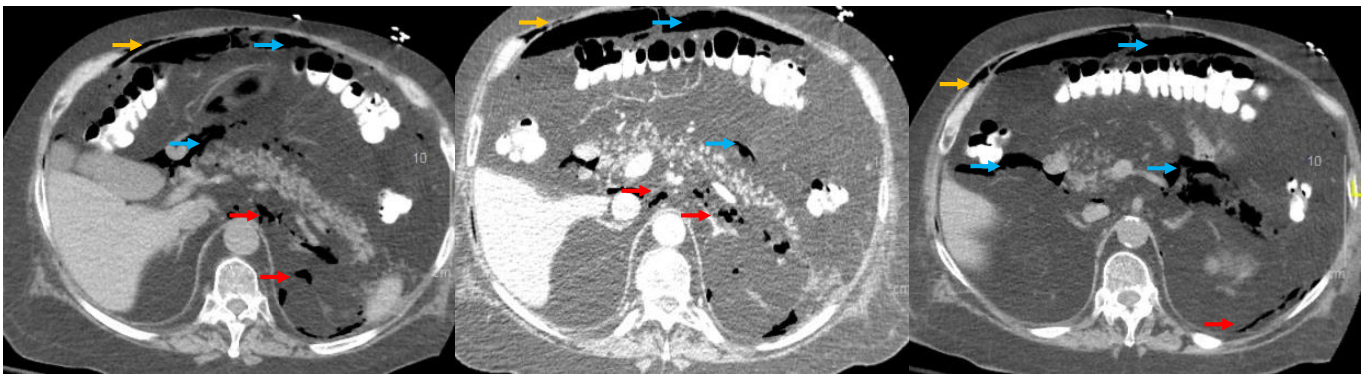
## Introduction

Free air within deep organ spaces such as the mediastinum or peritoneum are usually signing of life-threatening pathology. Formally known as pneumomediastinum (PM) and pneumoperitoneum (PP), these findings are well known for their association with perforated hollow organs and fulminant infection. The majority of patients presenting with these findings will be in extremis, requiring emergent surgery to salvage any chance of survival. Despite this common knowledge, free air is not always such an ominous finding. Although rare, there are cases in which free air can be managed without surgery. The finding of free air in such cases has been termed benign, primary, or non-surgical. Free air in these cases is usually confined to a signal body cavity, i.e., either the peritoneum or mediastinum. Here, we describe the case of a patient who was managed conservatively after

presenting with massive amounts of free air in both the mediastinal and peritoneal cavities.

## Case

A 70-year-old gentleman presented to the emergency department (ED) with a chief complaint of left flank pain. The pain had started suddenly earlier that day, located in the left flank and radiating to the groin. It was sharp, constant, and associated with urinary retention. His medical history consisted of deep venous thrombosis, kidney stones, chronic back pain, and obstructive sleep apnea that had been treated with continuous positive airway pressure (CPAP) every night for the past 15 years. He had no surgical history. Computed tomographic (CT) imaging of the abdomen/pelvis was obtained in the ED shortly after arrival and showed extensive pneumoperitoneum and free air in the retroperitoneum [figure 1].



**Figure 1.** Axial CT images displaying free air in the abdominal wall (orange arrows), peritoneal cavity (blue arrows), and retroperitoneum (red arrows).

There was a large focus of free air adjacent to a segment of diverticuli in the descending colon [figure 2].

Additionally, a chest X-ray and subsequent chest CT were both notable for pneumomediastinum with dissection of air into the soft tissues of the neck [figure 3]. With concern for perforated diverticulitis, general surgery was consulted emergently.

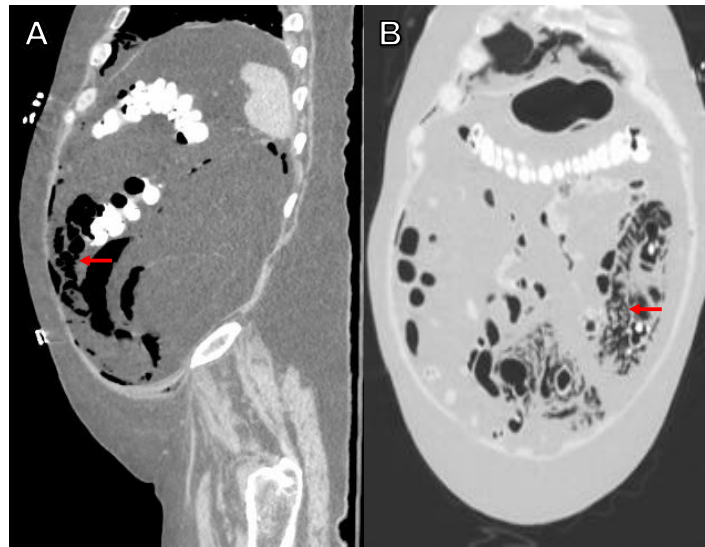
By the time he was evaluated by a surgeon, the patient had had several incontinent voids that were associated with resolution of his previous

flank pain. On exam, he was afebrile and hemodynamically stable with mild sinus tachycardia [98.5° F, 133/96 mmHg, 103 beats/min, 17 respirations/min]. He was alert, lucid, and in no distress. Examinations of his heart and lungs were unremarkable. His abdomen was soft, mildly distended, and non-tender in all quadrants, even with deep palpation. There were no signs of peritonitis. Laboratory studies were unremarkable [WBC count 9.2 without left shift, hemoglobin 14.1, platelet count 215, lactate 1.1, lipase 145, INR 1.0, electrolytes and liver enzymes were all within normal limits]. A urine analysis showed

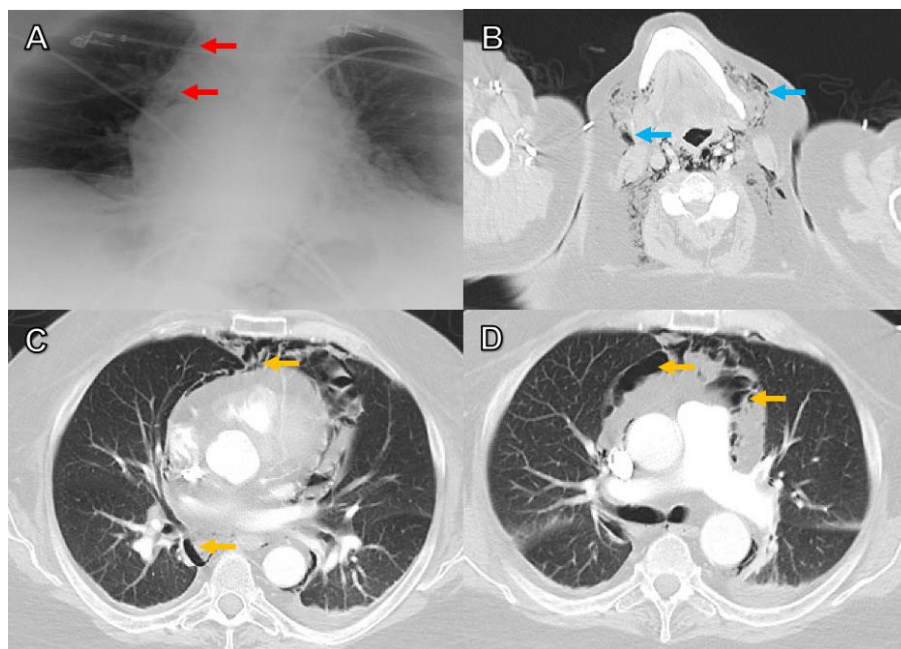
trace red blood cells but was otherwise normal. Despite the ominous findings on his imaging, we elected to forego immediate operative exploration in light of the patient's other reassuring objective findings. He was made NPO and admitted to the hospital for close observation.

The patient's condition remained unchanged throughout the night and following morning. A small bowel series was obtained and showed

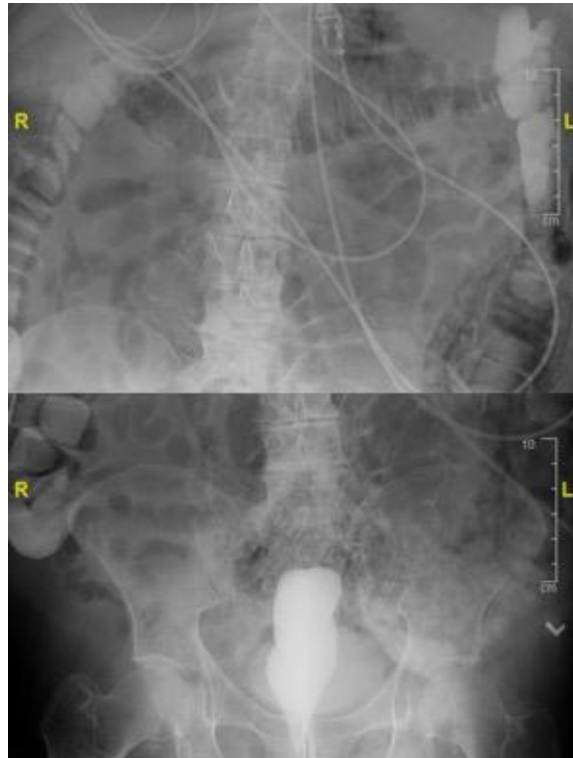
normal transit of contrast without any evidence of perforation. His labs remained within normal limits. He tolerated advancement to a regular diet and was having bowel movements per his usual routine. Abdominal x-rays displayed stable pneumoperitoneum and contrast reaching the rectum without extravasation [figure 4]. The patient was discharged home with plans to follow-up for an outpatient colonoscopy.



**Figure 2.** A) Abdominal CT (sagittal view) showing pneumoperitoneum with a large focus of free air adjacent to the descending colon (red arrow). B) Abdominal CT (coronal view, lung window) showing pneumoperitoneum with a large focus of free air adjacent to the descending colon (red arrow).



**Figure 3.** A) Chest X-ray displaying pneumomediastinum (red arrows). B–D) Axial CT images displaying severe pneumomediastinum (orange arrows) with dissection of air into the soft tissues of the neck (blue arrows).



**Figure 4.** Abdominal X-rays showing non-obstructive bowel gas patterns and contrast reaching the rectum without extravasation.

## Discussion

Consults for free air have put many a surgeon on edge. Such a finding is usually indicative of pathology with imminent risk to life such as hollow viscus perforations, violations of the aerodigestive tract, and/or fulminant infection. Emergent surgery is usually required to prevent mortality in such cases. Despite this dogma, free air is not always a result of severe injury. It is estimated that 10% of patients with free air do not have any life-threatening pathology.<sup>[1]</sup> In these cases, free air is often classified as primary since it usually occurs without an identifiable source.

Primary PM is thought to result from intense shifts in intrathoracic pressure such as those seen with valsalva maneuvers or forceful coughing.<sup>[2]</sup> Classic presenting signs and symptoms include chest pain, dyspnea and subcutaneous emphysema.<sup>[3]</sup> An attributable trigger is found in approximately 75% of cases, the most common of which are cough, exercise or drug abuse.<sup>[4]</sup> Other known triggers include barotrauma from ventilator usage and even electronic

cigarettes.<sup>[5]</sup> With significant morbidity and mortality, esophageal perforation is a primary concern when patients present with PM. Esophageal perforation is estimated to cause approximately 10% of PM cases, with older age being a significant risk factor. The most reliable indicators of a true esophageal injury are leukocytosis and the presence of a pleural effusion.<sup>[6]</sup> Nonetheless, true insults to the esophagus or respiratory tree are quite rare in patients with suspected benign PM. Thus, extensive investigation to rule out such an insult is not warranted in the majority of cases.<sup>[7]</sup> Furthermore, prophylactic antibiotics are rarely indicated.<sup>[8]</sup> The majority of suspected benign PM cases can be managed conservatively with a short observational admission.

Iatrogenesis describes the common cause of benign PP. Retained postoperative air, placement of peritoneal dialysis catheters (PDC), mechanical ventilation, endoscopic procedures, and chest compressions can all give rise to free air within the peritoneal cavity.<sup>[9]</sup> In addition to acute complications, chronic iatrogenic benign PP is not uncommon, particularly in relation to



PDCs.<sup>[10]</sup> Non-iatrogenic benign PP is commonly related to respiratory disease. As with benign PM, coughing is among the more common causes of benign PP.<sup>[11]</sup> Asthma and COPD are typical comorbidities seen among these patients. Additionally, ventilator induced barotrauma can result in benign PP. In fact, some authors have postulated that ventilator induced barotrauma is the most common etiology.<sup>[12]</sup>

Although rare, there have been cases of benign free air presenting simultaneously in both the mediastinum and peritoneum. Traumatic injuries and invasive ventilation are commonly cited causes of simultaneous benign PM and PP.<sup>[13,14]</sup> Late complications of thorascopic surgery such as pleuro-pleural fistulas have also been implicated.<sup>[15]</sup> Contemporary theory for the mechanism of gaseous entry into these two separate cavities dictates that the air first begins in the lung and travels caudally. Animal and postmortem studies have demonstrated that air initially leaks into the pleural cavity by way of microscopic alveolar defects. Once in the chest, with enough time and pressure, the air eventually travels downward through the esophageal hiatus and into the retroperitoneal space via perivascular sheaths.<sup>[16]</sup> Finally, the air reaches a weak point in the peritoneum and breaks through, thus resulting in simultaneous PM and PP.

The only attributable cause for our patient's impressive imaging findings was his utilization of a home CPAP device. To our knowledge, this is the first case of concomitant benign PP and PM attributable to home CPAP therapy. Furthermore, this case was notable given that this patient was successfully managed without surgery. Exploratory laparotomy is a lifesaving operation in the armamentarium of surgeons. However, this procedure can also beget major morbidity and mortality. It is estimated that 1 in 5 patients who undergo emergent exploratory laparotomy will die.<sup>[17]</sup> Furthermore, the economic burden of an exploratory laparotomy can be significant, with a total cost exceeding \$10,000 in most cases.<sup>[18]</sup>

Thus, it the responsibility of surgeons to retain this operation as a last line of defense.

## Conclusion

To our knowledge, this is the first described case of simultaneous benign PP and PM resulting from home CPAP therapy. Free air can be seen without violation of the aerodigestive tract or fulminant infection. Although such cases are rare, awareness of benign PP and PM is a must for the acute care surgeon as it can prevent significant iatrogenesis from unnecessary operations. When free air is accompanied by a soft, nontender abdomen, and stable hemodynamics, the surgeon would be wise to give pause and observe the patient for a period of time before proceeding to the operating room.

## Conflicts of Interest and Source of Funding

The authors have no conflicts of interest to declare.

No funding was received for the production of this work.

Informed consent was obtained from the patient presented.

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