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Spontaneous pneumoperitoneum in pediatric patients: A case series

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ABSTRACT

INTRODUCTION: Pneumoperitoneum frequently results in emergent surgery because it typically indicates an abdominal viscus perforation. However, this may not always be the case. There have been few recent reports in the pediatric population that document cases of pneumoperitoneum which could be considered for non-surgical management.
PRESENTATION OF CASE: This case series presents three different instances of pediatric patients with radiographic evidence of pneumoperitoneum who were subsequently found to have no perforated viscus following surgical intervention.
CONCLUSION: We recommend that in the absence of peritoneal signs, fever, leukocytosis, significant abdominal pain, distension, or clinical deterioration, non-operative management be considered in pediatric patients with radiographic signs of pneumoperitoneum.

1. Introduction

Pneumoperitoneum, or air within the peritoneal cavity, frequently indicates a perforated abdominal viscus that requires emergent surgical intervention [1]. Pathology for adult patients can include perforation of stomach or duodenal ulcers, perforation of the small or large intestines secondary to inflammatory bowel disease, diverticular rupture, or cancer [2]. Once abdominal free air is found radiographically, it is important to determine if the patient requires an emergent surgery. However, not all cases of pneumoperitoneum indicate perforated abdominal viscus [3,4].

Given that surgery with exposure to general anesthesia can lead to an increase in morbidity and mortality for patients, it is important to shed light on cases of spontaneous pneumoperitoneum that might be better managed without surgical intervention. In the pediatric population, there have been few recent studies that document instances of spontaneous pneumoperitoneum that were managed non-surgically. In this case series we present three different pediatric patients who were found to have radiographic evidence of pneumoperitoneum and underwent emergent laparotomy in which no perforated viscus was found.

2. Case series

2.1. Case 1

An 11-year-old male presented to the emergency department with a one-day history of pain in his left shoulder, back, and abdomen. He had a past medical history significant for polymyositis and systemic juvenile idiopathic arthritis for which he was taking steroids, methotrexate, and mycophenolic acid. He also had a history of total anomalous pulmonary venous return, which was repaired surgically during infancy. One month prior to presentation, the patient's mother stated that he underwent a thoracoscopy with biopsy of lung parenchyma for chronic pneumonia. On examination, his abdomen was soft and non-distended, but diffusely tender. Bowel sounds were active in all four quadrants and no rebound tenderness or guarding was noted. The patient was afebrile in the emergency department with a white blood cell (WBC) count of 30.3 k/μL. An abdominal CT and chest X-ray performed in the emergency department showed air under the right and left hemidiaphragm (Fig. 1) with no identifiable source of the free air. The patient underwent an emergent exploratory laparotomy due to concern for a perforated peptic ulcer from chronic steroid use. Laparotomy was chosen due to surgeon preference. Air was noted to escape upon opening of the parietal peritoneum, however no free fluid was seen. The bowel, colon, retroperitoneal space, retrogastric space, stomach, and duodenum were all examined. There were no signs of an intraabdominal inflammatory process or visceral perforation. The patient tolerated the surgery well and remained stable and afebrile postoperatively. He was discharged home five days later, and had no post-operative complications.

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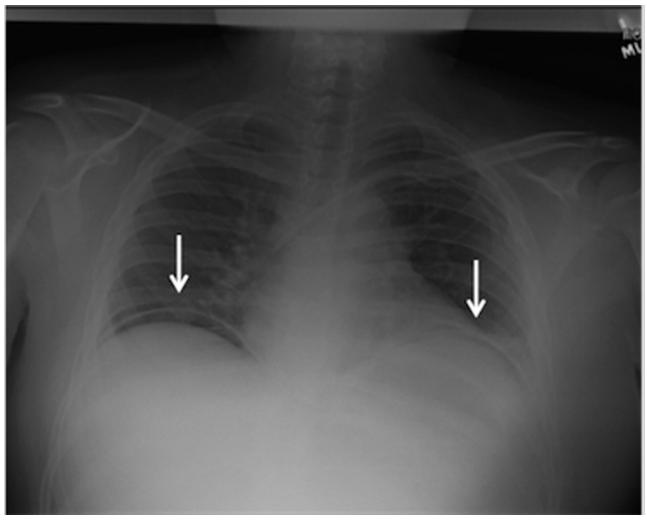

Fig. 1. Case 1—Chest X-ray with free air under the right and left hemidiaphragm.

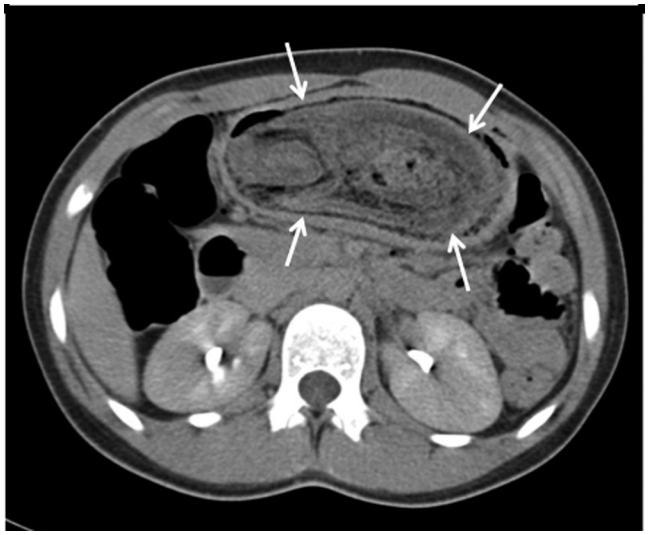

Fig. 2. Case 2—Abdominal CT with large bezoar.

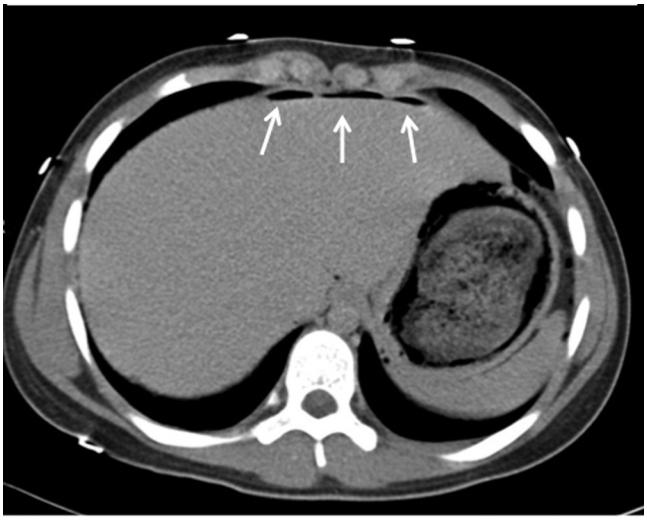

Fig. 3. Case 2—Abdominal CT with pneumoperitoneum.

Fig. 4. Case 3—Abdominal CT with pelvic debris.

2.2. Case 2

A 13-year-old female presented with a four-day history of abdominal pain. She had a past medical history significant for depression, anxiety, and trichotillomania. On examination, her abdomen was soft, non-distended, with tenderness to palpation in the epigastric region, and rebound tenderness. She was afebrile with a WBC count of 14.2 k/μL. An abdominal CT scan demonstrated a large bezoar within the stomach (Fig. 2) and intraperitoneal free air (Fig. 3). A chest X-ray was not performed. The patient then underwent an emergent laparotomy because of concern for perforation of the stomach due to the bezoar. Inspection of the peritoneal cavity, revealed no signs of perforation, but the stomach was markedly distended. A gastrotomy was performed revealing a large trichobezoar completely obstructing the gastric outlet. The trichobezoar was removed and the abdomen was irrigated and closed. The patient remained stable after the procedure and was discharged home three days later.

2.3. Case 3

A 10 year-old female presented to the emergency department with a one-day history of right-sided abdominal pain with periumbilical radiation, nausea, vomiting, and anorexia. Her past medical history was significant for recurrent urinary tract infections. On examination, her abdomen was soft, non-distended, tender to palpation in the right lower quadrant, with guarding, and no rebound tenderness. Rovsing and oburator signs were positive. The patient was afebrile with a WBC count of 20.0 k/μL and urinalysis was positive for nitrites and leukocyte esterase. An abdominal/pelvic CT showed scattered foci of air in the right upper quadrant, left lower quadrant, and left hemipelvis. The Appendix was noted to appear normal and debris was visualized in the gynecologic pelvis (Fig. 4). The patient underwent a diagnostic laparoscopy at which time purulent material was visualized in the pelvis. The stomach, small bowel, colon, appendix, and pelvis were examined, but no perforations were seen. The operation was converted to an open laparotomy due to poor visualization, and the ovaries and uterus were noted to be normal at this time. Following abdominal closure, a pelvic exam was performed revealing purulent material in the vagina with an intact hymen and no signs of sexual trauma. Culture and grain stain of peritoneal and vaginal fluids revealed no

organisms. The patient remained afebrile with no post-operative complications, and was discharged home after receiving a five-day course of piperacillin/tazobactam.

3. Discussion

Demonstration of pneumoperitoneum with abdominal imaging is almost always considered to represent a surgical emergency. It has been estimated that pneumoperitoneum results from visceral perforation in 85–95% of all cases [1,3,5,6]. This implies that a number of cases of pneumoperitoneum are not the result of perforation, giving rise to the concept of "non-surgical" pneumoperitoneum. While cases of non-surgical pneumoperitoneum have been well documented in adults, evidence within the pediatric population has been scarce. As with adults, it was historically believed that pneumoperitoneum in children almost always resulted from a perforated viscus [7].

The documented causes of non-surgical pneumoperitoneum are numerous and are categorized as thoracic, abdominal, gynecological, idiopathic, and pseudopneumoperitoneum [1]. Pneumoperitoneum can also be a complication of cardiopulmonary resuscitation, mechanical ventilation, gynecologic manipulation, peritoneal dialysis, and gastrointestinal endoscopic procedures [1,8]. Previous abdominal surgeries are also an obvious cause of pneumoperitoneum, however, 97% of cases of post-operative free air resolve within five days [9].

In children, the most common causes of non-surgical pneumoperitoneum are peritoneal dialysis, endoscopic gastrointestinal procedures, pneumatosis cystoides intestinalis, and mechanical ventilation [3]. In the pediatric population, pneumoperitoneum occurs in 1–3% of infants who are mechanically ventilated [8]. In the case of our first patient, chronic lung disease was believed to be the most likely cause of this patient's pneumoperitoneum, given that no other source of perforation or infection was identified.

Perforated pneumatosis cystoides intestinalis, caused by infection with a gas-producing bacterium, is thought to be the most common cause of spontaneous pneumoperitoneum in adults without perforation [10,11]. In adults, pneumatosis cystoides is considered to be idiopathic or secondary to chronic medical conditions [12]. In the pediatric population, pneumatosis cystoides may represent the first sign of serious underlying diseases such as necrotizing entercolitis (NEC), peptic ulcers, pyloric obstruction, intestinal obstruction, inflammatory bowel disease and connective tissue disease [8].

Subclinical perforations may be a common route for the development of idiopathic pneumoperitoneum, but these perforations are thought to resolve without surgical intervention [13]. In the setting of obstruction, pneumoperitoneum has been proposed to develop via dissection of air through a distended intestional wall [14]. In our second case, this would explain the presence of pneumoperitoneum despite the absence of gross perforations. Though, this patient required surgery given the presence of gastric outlet obstruction, this makes a case for the proposed idea of subclinical perforations in the setting of gastrointestinal obstruction.

Gynecologic causes of spontaneous pneumoperitoneum occur less often in the pediatric population, as they include etiologies such as pelvic inflammatory disease (PID), sexual intercourse, pelvic examination, and sexual abuse [8]. However, gynecologic causes should never be completely ruled out in female patients, regardless of age, until a full workup can be performed. In the case of our third patient, it is unknown whether the pelvic debris originated in the abdomen or the vagina. It is worth noting that gas-producing, anaerobic bacteria are another potential source of free air in this patient, which are commonly involved in pelvic inflammatory disease. These bacteria would be killed from air exposure during surgery, complicating the diagnosis. Looking retrospectively, this patient could have been managed conservatively, following guidelines for treatment of pelvic inflammatory disease, as the patient's clinical improvement was most likely due to antibiotic therapy.

While imaging modalities have greatly aided in our detection of pathology requiring emergent surgery, the clinical picture of the patient needs to remain the primary determinant of the need for operative management. Isolated radiographic findings of pneumoperitoneum, whether on x-ray or CT scan, should not necessarily be considered as an indication for emergent laparotomy. And though it presents a pain-staking dilemma, idiopathic causes of pneumoperitoneum should still be considered. For adults it has been suggested that in the absence of peritoneal signs, fever, leukocytosis, significant abdominal pain, or distension non-operative management be considered first [1]. We believe a similar clinical judgment could be considered in pediatric patients. If it is deemed that surgery is necessary, diagnostic laparoscopy should be considered first as it represents a safe and simple diagnostic and therapeutic tool for the management of abdominal free air.

4. Conclusion

Though radiographic evidence of pneumoperitoneum is considered an ominous pathologic sign, not every case warrants an emergent laparotomy. Regardless of etiology, we recommend, in the absence of peritoneal signs, fever, leukocytosis, significant abdominal pain, distension, or clinical deterioration, non-operative management be considered in pediatric patients with isolated radiographic signs of pneumoperitoneum. In the event of an unclear diagnosis, clinical correlation can take precedence when determining the course of care.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

Not applicable.

Consent

The authors obtained consent to include the patients in this study from each of the patients' parents.

Author contribution

Caitlin Tallant—study concept, data collection, data analysis, interpretation, writing the paper, editng the paper.

Aaron Tallant—study concept, data collection, data analysis, interpretation, writing the paper, editing the paper.

Jason Nirgiotis—data analysis, interpretation, writing the paper, editing the paper.

Janet Meller—study concept, data collection, data analysis, interpretation, writing the paper, editng the paper.

Guarantor

Caitlin Tallant, Janet Meller.

Informed consent

Informed consent was obtained from all participants included in the study.

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