

## Case Report

# Jacuzzi-Induced Pneumoperitoneum: Case Report and Literature Review

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## Abstract

### Description

Radiographically-detected pneumoperitoneum in the setting of acute onset abdominal pain is a classic case among surgical emergencies. The spectrum of etiology ranges from benign to catastrophic, and the ability to differentiate depends in large part on the history and physical exam findings. Included among non-surgical types of pneumoperitoneum are (1) post-operative, (2) diagnostic/experimental, (3) gynecologic tract air entry, (4) the difference in intra- and extra-alveolar pressures, pneumothorax-associated and (5) miscellaneous. Jacuzzi-induced pneumoperitoneum is an extremely rare form of non-surgical pneumoperitoneum. We discuss a case of a 32-year-old female presenting with pneumoperitoneum and acute onset abdominal pain secondary to vaginal insertion onto a Jacuzzi jet. We describe the workup and management of this case and perform a literature review of reported cases of Jacuzzi-induced pneumoperitoneum. Although its presentation is dramatic, a prudent physical exam, history and appropriate imaging are key to the management of this non-surgical condition.

### Keywords

pneumoperitoneum; pneumoperitoneum/etiology; pneumoperitoneum/diagnostic imaging; peritoneal diseases; Jacuzzis; accidental injuries

## Introduction

Radiographically-detected pneumoperitoneum in the setting of acute onset abdominal pain is a classic case among surgical emergencies. The spectrum of etiology ranges from benign to catastrophic, and the ability to differentiate depends in large part on the history and physical exam findings. Included among non-surgical types of pneumoperitoneum are (1) post-operative, (2) diagnostic/experimental, (3) gynecologic tract air entry, (4) the difference in intra- and extra-alveolar pressures, pneumothorax-associated and (5) miscellaneous.<sup>1-5</sup> Jacuzzi-induced pneumoperitoneum is an extremely rare form of non-surgical pneumoperitoneum. Although its presentation is dramatic, a prudent physical exam, history and appropriate imaging are key to the management of this non-surgical condition.

## Case Presentation

A 32-year-old female with no past medical history presented with acute onset abdominal pain localized to the epigastrium. Vital signs were normal, and the patient was afebrile. Laboratories were normal, demonstrating hemoglobin of 13.6 g/dL, white blood cell count of 8000 and lactic acid of 0.8 mm. Upon physical exam, the patient's abdomen was peritonitic. The patient underwent a contrast-enhanced computed tomography (CT) of the abdomen and pelvis revealed pneumoperitoneum localized to the right upper quadrant with mild gastric and small bowel mucosal thickening, raising suspicion for a perforated duodenal ulcer. (**Figures 1 and 2**)

Emergency exploration was indicated, and the patient's clinical stability permitted a laparo-



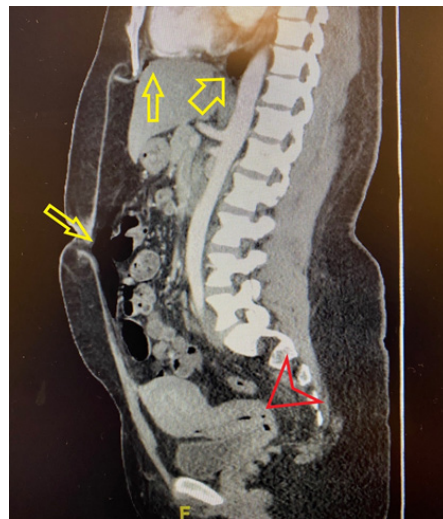
**Figure 1.** Coronal view of CT abdomen/pelvis demonstrating pneumoperitoneum with multiple foci of free air under the diaphragm and around the liver (arrows).

scopic approach. Laparoscopic examination of the stomach, duodenum and small and large bowel failed to identify a perforation. An intra-operative esophagogastroduodenoscopy also failed to demonstrate any perforations or luminal irregularity. The decision was made to leave a drain and transfer the patient to the ICU with nasogastric decompression and antibiotic coverage. Post-operatively, discussion with the patient's spouse elucidated the fact that prior to arrival to our facility, they had been engaging in sexual activity in their Jacuzzi, with the patient having inserted the Jacuzzi jets into her vagina for sexual pleasure. Further review of the imaging following this new knowledge demonstrated extensive air within the uterus, which had initially gone unnoticed.

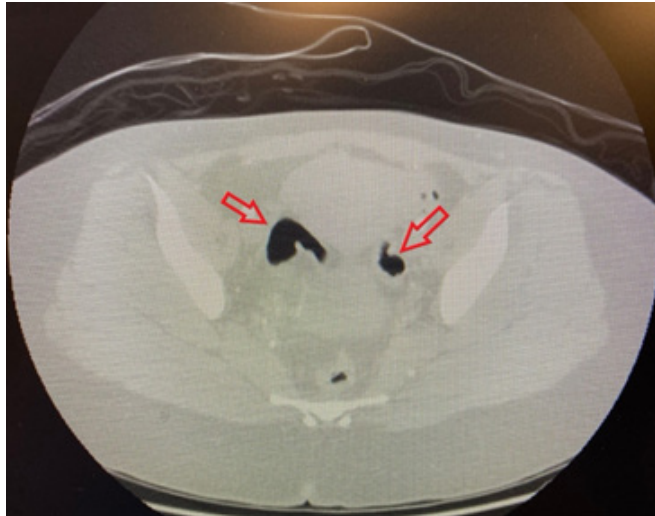
**(Figure 3)** In light of this new information, the patient was observed for 24 hours with labs and vitals remaining stable. The abdominal exam remained unchanged. The patient was started on a liquid diet post-operative on day 1. The patient tolerated a normal diet and was discharged on postoperative day 2 in stable condition.

### Discussion

Pneumoperitoneum is classically a surgical emergency, with perforated hollow viscera accounting for about 41–90% of cases.<sup>1,2</sup> Perforated peptic ulcer disease is the most common surgical etiology to present with pneumoperitoneum, with 72% of cases demonstrating this finding.<sup>2</sup> Chest or abdominal plain film



**Figure 2.** Sagittal view of CT abdomen/pelvis demonstrating extensive free air throughout the abdomen (yellow arrows) and air within the uterus (red arrow).



**Figure 3.** Axial view of CT abdomen/pelvis demonstrating air within the fallopian tubes (arrows). Seen on “lung window.”

radiography is the primary diagnostic tool for detecting pneumoperitoneum.<sup>3</sup> Computed tomography (CT) examinations, however, have been shown to be more sensitive than abdominal radiographs for the detection of free intraperitoneal air.<sup>3</sup> Surgical causes of pneumoperitoneum typically require laparotomy for repair, resection or exclusion of the perforated viscus depending on the source.<sup>4</sup> This fact is especially true in patients who are hemodynamically unstable or demonstrate laboratory abnormalities.<sup>4</sup> Many reports describe pneumoperitoneum developing from non-surgical etiologies. Miller et. al in 1984 classified the causes of non-surgical pneumoperitoneum into 5 different etiologies: post-operative, diagnostic and experimental, gynecologic/fallopian tube air entry, difference in intra- and extra-alveolar pressures, pneumothorax-associated and miscellaneous.<sup>5</sup>

Multiple gynecologic causes of pneumoperitoneum have been described in the literature, including coitus,<sup>6-11</sup> oro-genital sex,<sup>12-15</sup> post-partum knee-chest exercises,<sup>6,16,17</sup> vaginal douching,<sup>6,7,21</sup> pelvic inflammatory disease,<sup>5</sup> hysterosalpingography,<sup>5</sup> pelvic examinations,<sup>6,7,18-20</sup> and aquatic sports.<sup>22</sup> Jacuzzi-induced pneumoperitoneum is an extremely rare cause of pneumoperitoneum, with only three previously reported cases in the literature, which are described below.<sup>23-25</sup>

The first reported case in the literature was from the United Kingdom in 2000, involving

a 56-year-old female who presented with abdominal pain following Jacuzzi use hours earlier.<sup>23</sup> The patient was mildly tachycardic and peritonitic. Pneumoperitoneum was demonstrated on abdominal radiographs. An exploratory laparotomy was performed demonstrating clear fluid and gas within the abdomen without evidence of perforated viscus. The patient was treated with antibiotics and discharged 48 hours later.

The second reported case was from the United States in 2004 involving a 49-year-old female who developed abdominal pain one day after slipping and falling in a Jacuzzi tub where she reported a feeling of air and water rushing into her vagina.<sup>24</sup> The patient's vitals and labs were normal. A physical exam demonstrated peritonitis. A CT of the abdomen and pelvis demonstrated a considerable amount of free intraperitoneal gas and equivocal mural thickening of the second portion of the duodenum. The patient was admitted for observation and did not undergo surgical exploration. She underwent an upper gastrointestinal series with water-soluble contrast that did not demonstrate any abnormality. The patient was subsequently discharged home.

The third and most recently reported case was from Hungary in 2013 involving a 61-year-old female who presented with diffuse abdominal pain without any other symptoms.<sup>25</sup> Chest and abdominal radiographs demonstrated free air under the diaphragms. The patient underwent

surgical exploration with a laparotomy, and no evidence of a perforated viscus or a source of peritonitis was found. Post-operatively, the patient admitted to her complaints developing after using the Jacuzzi.<sup>25</sup>

All 3 cases presented with severe abdominal pain following Jacuzzi use. The time frame for symptom development ranged between several hours to a day following Jacuzzi usage.<sup>23-25</sup> All patients demonstrated peritonitis upon clinical examination with normal vital signs and laboratories. Two patients were diagnosed with abdominal radiography. The remaining patient underwent both radiography and CT imaging. The patients diagnosed with pneumoperitoneum solely by plain film radiography underwent exploratory laparotomy.<sup>23,25</sup> The third patient was treated conservatively in a non-operative manner.<sup>24</sup> All patients were discharged home in stable condition within 72 hours of admission.

## Conclusion

Jacuzzi-induced pneumoperitoneum is a rare form of non-surgical pneumoperitoneum. A detailed physical examination and medical history are integral to diagnosis. As with other types of pneumoperitoneum, chest or abdominal radiography can demonstrate air beneath the diaphragms. A CT of the abdomen and pelvis is the preferred imaging modality as it can characterize the extent of pneumoperitoneum, detect any obvious signs of viscus perforation and can examine the pelvic organs for any air that could indicate pelvic entry. An accurate history and physical examination along with CT imaging and stable vitals and laboratory values can help diagnose this phenomenon. Patients with the appropriate history of Jacuzzi usage in combination with normal vital signs, laboratories and findings of an isolated pneumoperitoneum on CT imaging can be safely observed. Empiric broad-spectrum antibiotics are recommended until the patient demonstrates persistent clinical stability with improved abdominal pain on examination. Should the patient require exploration, a diagnostic laparoscopic examination of the abdomen can help to rule out a perforated viscus and avoid any extensive surgical interventions.

## Consent for Publication

The patient in the aforementioned case report

gave verbal and written consent for the case to be published.

## Authors' Contributions

Obteene Azimi-Ghomi was involved in the sourcing of dates and resources for the article and the editing of images. Obteene Azimi-Ghomi, Vasiliy Ovakimyan, and Deiter Brummond were involved in the writing, editing, and formatting of the case report. Gerardo Kahane was involved in the development of the focus of the article and provided advice regarding contextualization and development of the article.

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## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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