International Journal of Surgery Case Reports 130 (2025) 111289

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.elsevier.com/locate/ijscr

Case report

Ozone therapy-associated pneumoperitoneum in a patient with low back pain: A case report

Mohammadsadra Shamohammadi [a], Maryam Mazraeh [b], Ali Tayebi [b,*], Faranak Olamaeian [b], Hirbod Hadizadeh Moallem [b]

[a] Gastrointestinal and Liver Diseases Research Center, Iran University of Medical Sciences, Tehran, Iran
[b] Firoozabadi Clinical Research Development Unit (FACRDU), School of Medicine, Iran University of Medical Sciences (IUMS), Tehran, Iran

ARTICLE INFO

Keywords:
Ozone
Pneumoperitoneum
Low back pain
Treatment outcome
Case report

ABSTRACT

Introduction: Ozone therapy has been used for patients with low back pain due to disc herniation. Owing to its analgesic and anti-inflammatory properties, this method alleviates low back pain and often improves physical function through lumbar injection. Despite its therapeutic potential, the complications associated with ozone therapy are not yet fully understood.

Case report: A 57-year-old woman with a history of diabetes mellitus was admitted to the emergency department with acute abdominal pain and distension and chest pain, which occurred following her last session of ozone therapy. At first, the patient had been diagnosed with peritonitis based on initial symptoms. However, blood tests did not reveal any notable abnormalities. After identifying the presence of free air on the abdominal X-ray and the IV contrast-enhanced computed tomography scan of the abdomen revealed retroperitoneal and intraperitoneal air indicative of pneumoperitoneum and pneumoretroperitoneum. The patient was discharged in stable condition after five days of non-surgical and symptomatic treatment.

Discussion: This is a rare case of pneumoperitoneum and pneumoretroperitoneum, which also highlights a new complication of ozone therapy. Despite the exact pathophysiological mechanisms being unclear, the high pressure of ozone administration or technique may be the causative factors. Conservative management demonstrated favorable prognostic outcomes and an effective treatment response.

Conclusion: Spontaneous pneumoperitoneum presents with severe abdominal pain and the presence of free air in the abdominal cavity. Typically, it does not require surgical intervention. However, Conservative treatment resulted in a dramatic improvement in the initial clinical condition and decreased the amount of free air within the abdominal cavity.

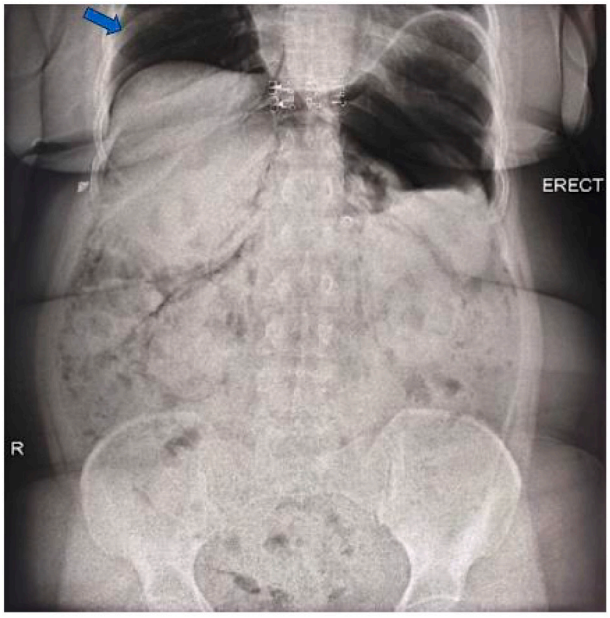
1. Introduction

Ozone therapy is utilized as an effective, safe, and less invasive treatment option for various medical conditions, particularly for acute and chronic lower back pain [1,2]. This intervention is noted for its antioxidant, anti-inflammatory, and analgesic properties [3]. Despite its therapeutic benefits, the complications of ozone therapy remain understudied in the literature [4–7]. Peritonitis is a significant condition characterized by inflammation of the peritoneum, often spreading via body fluids. The diagnosis is confirmed through physical examinations, imaging studies, and blood tests [8,9].

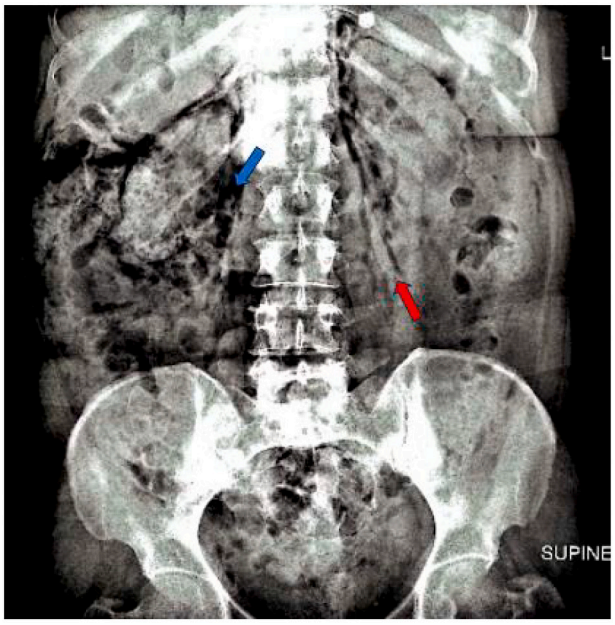
The pneumoperitoneum is free air within the peritoneal cavity, most commonly caused by viscus perforation [10,11]. Additionally, pneumoperitoneum sometimes occurs spontaneously, known as non-surgical pneumoperitoneum, which is associated with iatrogenic and other causes [12]. Spontaneous Pneumoperitoneum (SP) usually presents without symptoms and is discovered accidentally on imaging for different reasons [13]. Diagnostic imaging, such as plain radiographs and computed tomography (CT) scans, is crucial for identifying the presence of free air, as well as determining the source of perforation [14]. SP is often treated by observational and conservative management if the patient's assessments do not indicate gastrointestinal (GI) perforation, peritonitis, or cardiovascular instability [15,16]. This case report adheres to the 2023 SCARE Guidelines, ensuring thorough documentation of surgical cases [17].

* Corresponding author.
E-mail address: Tayebi81@gmail.com (A. Tayebi).

https://doi.org/10.1016/j.ijscr.2025.111289
Received 31 January 2025; Received in revised form 9 April 2025; Accepted 11 April 2025
Available online 13 April 2025



(A)



(B)

Fig. 1. Plain abdominal X-ray showing free air under the diaphragm (A)/ pneumoperitoneum (blue arrow) and around the kidneys and psoas muscles (B)/pneumoretroperitoneum (red arrows). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

2. Case presentation

On the evening of August 5, 2024, a 57-year-old female presented to the emergency department of Firoozabadi Hospital with abdominal pain that had started 12 h earlier. The patient had a history of type II diabetes mellites, hypertension, and ischemic heart disease for which she was treated with indomethacin 25 mg tablet three times daily, metformin 500 mg twice daily, and methadone 5 mg tablet in severe pain episodes arbitrarily but had stopped heart medications four months back on her own decision. The patient had been diagnosed with L4-L5 lumbar disc herniation 5 years ago. On the orthopedic surgeon's recommendation, ozone therapy was chosen to treat the disc herniation, as a non-surgical alternative. The patient underwent their initial session of ozone therapy without intravenous anesthesia and had no side effects. A month after her first ozone therapy session, the patient underwent a second session at another center. Ten minutes following this procedure, she developed abdominal pain and distension. Although she initially returned home, her condition progressively worsened over the next 12 h, ultimately requiring transfer to our hospital via Emergency Medical Services for comprehensive evaluation and management.

The patient reported nausea, abdominal distension, abdominal pain, and chest pain. On physical examination, the patient had generalized tenderness, with no rebound tenderness and no guarding.

At the time of admission to the hospital, the patient's general condition was stable, and the following vital signs were measured: temperature 37.2 °C, respiratory rate 17 per minute, pulse rate 85 per minute, blood pressure 157/98 mmHg, and oxygen saturation 96 %.

On chest and abdominal X-rays, subdiaphragmatic, perirenal, and psoas-free air was noted (Fig. 1). A CT scan with IV contrast demonstrated the presence of intra-abdominal as well as retro-abdominal scattered free air but no free fluid was noted (Fig. 2). The Laboratory results did not demonstrate any clinically significant abnormalities in the CBC that would indicate an infectious or inflammatory condition, nor were there any pancreatic or liver abnormalities. Moreover, no significant elevations in C-reactive protein (CRP) levels were noted and Urine analysis was Quite normal (Table 1). In addition, the ECG of the patient was normal and troponin was not detectable.

Evaluation by the general surgeon revealed no free fluid in the abdomen or significant findings in arterial blood gas analysis. Consequently, the patient was diagnosed with pneumoretroperitoneum and pneumoperitoneum secondary to ozone therapy. Instantly, the patient was admitted to the intensive care unit (ICU) and was approved for conservative treatment.

To correct electrolyte imbalances and hydration, the patient received normal saline 0.9 % at 10 mL/kg/h intravenous (IV), three times daily. Analgesic medications included Paracetamol 1 g IV, three times daily, and pantoprazole 40 mg IV, twice daily. Additionally, metronidazole 500 mg IV, three times daily, and meropenem 500 mg IV, three times daily were empirically added to the treatment regimen. The internal medicine specialist ordered that the patient's blood sugar be checked every 6 h, following the regular insulin protocol (if blood sugar (BS) $\geq$ 200) or administering a glucose vial 50 mL IV (if BS $\leq$ 70). The patient was kept nil per os (NPO) and a nasogastric (NG) tube was inserted.

The patient's abdominal pain and other symptoms gradually improved. By the second day, she no longer required analgesics for pain relief. However, her nausea persisted until the third day. The patient resumed oral intake and the NG tube was removed on the fourth day. A CT scan without contrast demonstrated that the amount of free air in the abdomen has considerably decreased (Fig. 3). At last, the patient was

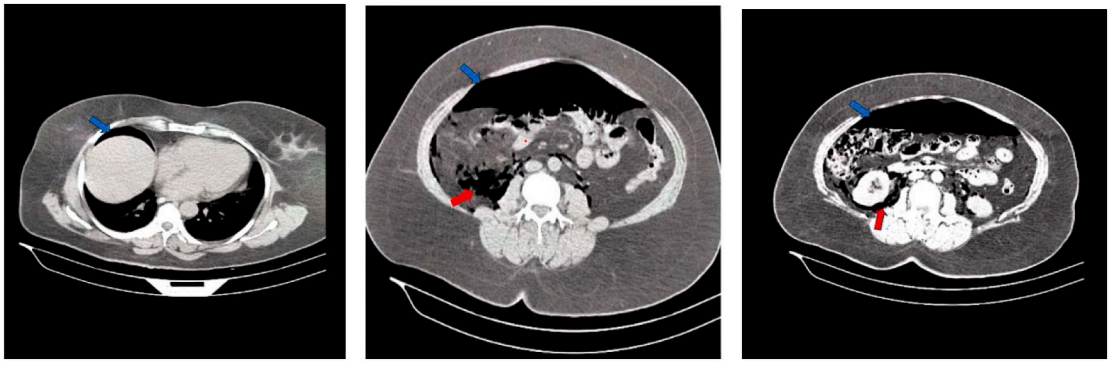


Fig. 2. IV Contrast-enhanced computed tomography of the abdomen on the first day of admission showing pneumoperitoneum (blue arrows) and pneumoretroperitoneum (red arrows). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

medically stable and discharged after five days with the knowledge of clear potential warning signs that should be returned to the hospital. At the 1-month follow-up, the patient remained asymptomatic, with no recurrence of previous symptoms. Furthermore, there were no complications or significant findings observed, supporting a favorable and uncomplicated recovery.

3. Discussion

In this case report, we described a woman who suffered from abdominal pain caused by pneumoretroperitoneum and pneumoperitoneum which was concluded to be a complication as a result of ozone therapy. The diagnostic process ruled out GI rupture due to the absence of free fluid in the imaging studies and unremarkable inflammatory biomarkers. Other differential diagnosis, such as infectious, gynecological, and cardiac, were also ruled out. Based on the findings, the patient was not a candidate for surgical intervention, and conservative management was utilized. During the hospital stay, the patient was monitored in the ICU. Gradually, over the course of five days, his symptoms improved. The amount of peritoneal free air was also decreased during the next follow-up.

The pathophysiology and exact mechanism underlying this complication associated with ozone therapy remain undefined. However, it is hypothesized that factors such as high-pressure ozone administration or improper instrument insertion may have contributed to the concurrent development of pneumoretroperitoneum and pneumoperitoneum. Further investigations are essential to clarify these mechanisms and minimize the potential risks associated with this procedure. This case report demonstrated the importance of caution in practice and considering the risks of ozone therapy.

Pneumoperitoneum refers to the presence of gas within the peritoneal cavity, a critical condition that often requires emergency management [10]. It presents a diagnostic challenge with a wide range of differential diagnoses and a spectrum of clinical presentations [18]. Several conditions can cause pneumoperitoneum; these include malignancies, iatrogenic injuries, ¬and gastrointestinal ulcers. Perforated viscus is the most frequent cause and necessitates surgical intervention in most cases [19]. In contrast, the retroperitoneum is located posterior to this layer, consisting of the parietal peritoneum and the transversalis fascia and encloses vital structures such as the kidneys, adrenal glands, and portions of the gastrointestinal tract [20]. Despite separation of these two spaces, they maintain critical anatomical and functional relationships through shared structures like the transverse mesocolon and transitional zones such as the iliac crest [21].

Pneumoperitoneum has a variable range of clinical presentation that ranges from asymptomatic cases detected accidentally to acute abdominal emergencies [13]. Common features include abdominal pain, chest pain, nausea, vomiting, and these features can develop into severe sepsis extremely quickly if not promptly treated [12]. Imaging is an important component of the diagnostic measures for pneumoperitoneum; upright chest radiographs frequently establish the diagnosis by revealing free air under the diaphragm. However, the sensitivity of this modality is limited, and a CT scan is needed to confirm the diagnosis of pneumoperitoneum. CT scans are particularly valuable as they provide detailed information about the abdominal organs and can accurately identify the exact site of perforation or injury [14].

When other potential causes have been ruled out, the presence of free air in the peritoneal cavity without evidence of viscus perforation is known as SP [22]. To prevent unnecessary surgical interventions, SP requires immediate diagnosis. The management of SP depends on the

Table 1
Laboratory data (Hematology, Biochemistry, TROPONIN, VBG (venous blood gas)).

Test	Result	Unit - Reference value
Hematology		
W.B.C	7.5	4.0–10 × 1000/mm^3
Mixed	6.3	%
Segment	65.5	%
Lymphocyte	28.2	%
Hb	12.7	Female: 12_16 gm/dL
Hct	40.7	39 %–52 %
M.C.V	87.53	77–97 fL
M.C.H	27.31	26–32 pg
M.C.H.C	31.2	32 %–36 %
Platelet	258	140–440 × 1000/mm^3
RDW	14	11 %–16 %
PT	13	<13.5
INR	1	0.9–1
PTT	27	30–45
CRP	5	≥10 mg/L
Biochemistry		
Blood sugar	123	Adult Normal: <140 Impaired glucose tolerance: 140–199 Diabetes mellitus: ≥ 200
B.U.N	19	8–26 mg/dL
Creatinine	0.8	0.6–1-3 mg/dL
AST	20	<31 U/L
ALT	19	<31 U/L
Alk. P	174	64–306 U/L
Amylase	71	<100 U/L
Serum Na	132	136–145 mmol/L
Serum K	4.3	3.7–4.8 mmol/L
Lipase	46	Adult <60 U/L
TROPONIN		
Troponin rapid	Negative	
VBG		
PH	7.41	7.31–7.41
PCO2	46.1	35–40 mmHg
PO2	39	41–51 mmHg
HCO3	25.6	22–26 mmol/L
02 sat	73.7	70–80 %
Urine analysis		
Color	Yellow	
Appearance	Clear	
PH	6.5	
Sp.Gravity	1.013	
Protein	Negative	
Blood/Hb	Negative	
Glucose	Negative	
Nitrite	Negative	
Ketone	Negative	
WBC	1–2	
RBC	0–1	
Epithelial	1–2	
Bacteria	Rare	

Abbreviations: W.B.C: White Blood Cell count/Hb: Hemoglobin/Hct: Hematocrit/M.C.V: Mean Corpuscular Volume/M.C.H: Mean Corpuscular Hemoglobin/M.C.H.C: Mean Corpuscular Hemoglobin Concentration/RDW: Red Cell Distribution Width/PT: Prothrombin Time/INR: International Normalized Ratio/PTT: Partial Thromboplastin Time/CRP: C-Reactive Protein/B.U.N: Blood Urea Nitrogen/AST: Aspartate Aminotransferase/ALT: ALT Alanine Aminotransferase/Alk.P: Alkaline Phosphatase/Serum Na: Sodium/Serum K: Potassium/VBG: Venous Blood Gas/PH: Potential of Hydrogen/PCO2: Partial Pressure of Carbon Dioxide/PO2: Partial Pressure of Oxygen/HCO3: Bicarbonate/02 sat: Oxygen Saturation/Sp.Gravity: Specific Gravity/RBC: Red Blood Cells.

clinical status of the patient. Conservative management is the cornerstone for patients who are minimally symptomatic and have stable hemodynamics [15,16,18,22,23]. This approach includes bowel rest, use of broad-spectrum intravenous antibiotics, repletion of electrolyte repletion, and intravenous fluid replacement. H2-receptor antagonists and proton-pump inhibitors should be used in patients with upper abdominal pneumoperitoneum [22]. Clinical monitoring is crucial to detect any deterioration that may necessitate surgical intervention. SP generally carries a favorable prognosis with conservative management [15,16,18].

Ozone therapy is one of the modalities that have been used for the treatment of diverse conditions which include: the management of chronic wounds, chronic and acute low back pain, and vascular and respiratory diseases. A mode of therapy that can be termed a less invasive and safer procedure via intramuscular or paravertebral lumbar injection, where patients report great pain relief and enhanced functional activities [1,2]. Compared with many anti-inflammatory pain reduction drugs, ozone therapy is much less morbid and provides better pain relief in patients with herniated discs [23]. These properties are a result of the ability of ozone to enhance oxygen circulation, to be an anti-inflammatory agent, to be an analgesic as well as an antioxidant [3,24]. However, in as much as it is minimally invasive and has proven advantages, ozone therapy is still controversial and requires more studies to understand its potential complications and risks.

Peritonitis is very serious in nature and characterized by inflammation of the peritoneum, which can be localized or generalized. There are three types of peritonitis: primary, secondary, and tertiary, which are developed by different causes [8]. This is usually confirmed by imaging and blood tests. As peritonitis can spread to the bloodstream and become septic if severe, it is considered a medical emergency [8,9]. Although the patient exhibited generalized tenderness during examination, no evidence of rebound tenderness or guarding was observed. Furthermore, the absence of systemic signs of infection, including tachycardia, hypotension, and leukocytosis, further reduced the clinical suspicion of peritonitis in this case.

4. Conclusion

This case presented a rare complication of ozone therapy, characterized by pneumoretroperitoneum and pneumoperitoneum, without gastrointestinal perforation or peritonitis. Based on prompt imaging and clinical evaluation, surgical intervention was avoided and the patient was successfully treated with conservative management. The findings highlight the necessity to demonstrate the relationship between ozone therapy procedures and the occurrence of pneumoretroperitoneum and pneumoperitoneum, as well as to clarify their risks and mechanisms.

Abbreviations

CT	computed tomography
NPO	nil per os/nothing by mouth
NG	nasogastric
BS	blood sugar
ICU	intensive care unit
IV	intravenous
SP	spontaneous pneumoperitoneum
BS	blood sugar
GI	gastrointestinal

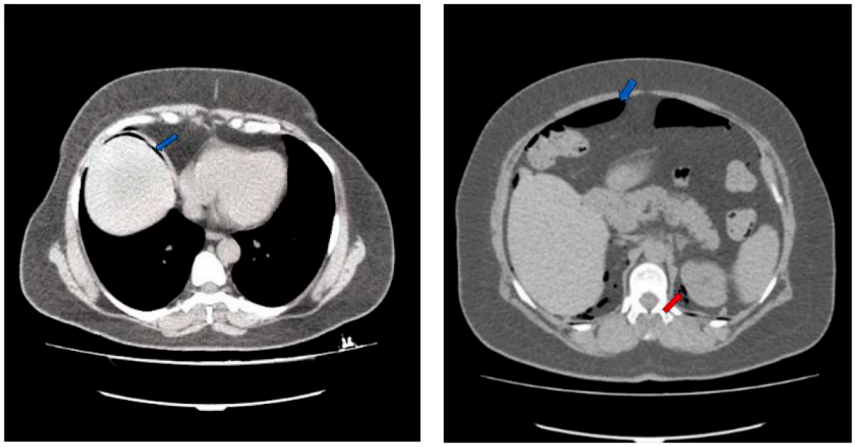


Fig. 3. IV Contrast-enhanced computed tomography after 5 days of admission showing significantly decreased free air level in peritoneum (blue arrow) and retroperitoneum (red arrow). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Author contribution

Writing – original draft/Project administration: Dr. Ali Tayebi and Dr. Mohammadsadra Shamohammadi.

Data Collection/Patient's doctor: Dr. Maryam Mazraeh and Dr. Hirbod Hadizadeh Moallem.

Faranak Olamaeian: review and editing, supervision.

Consent

Informed written consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal upon request.

Ethical approval

Ethical approval by the Research Committee of Iran University of Medical Sciences was not necessary, as the format of this article is a case report.

Guarantor

Dr. Ali Tayebi and Dr. Mohammadsadra Shamohammadi.

Research registration number

Not applicable.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijscr.2025.111289.

References

[1] M.E.G. Serra, J. Baeza-Noci, C.V. Mendes Abdala, M.M. Luvisotto, C.D. Bertol, A. P. Anzolin, The role of ozone treatment as integrative medicine. An evidence and gap map, Front. Public Health (2023) 10.

[2] R. Di Mauro, G. Cantarella, R. Bernardini, M. Di Rosa, I. Barbagallo, A. Distefano, L. Longhitano, N. Vicario, D. Nicolosi, G. Lazzarino, et al., The biochemical and pharmacological properties of ozone: the smell of protection in acute and chronic diseases, Int. J. Mol. Sci. 20 (3) (2019) 634.

[3] A. de Sire, N. Marotta, M. Ferrillo, F. Agostini, C. Sconza, L. Lippi, S. Respizzi, A. Giudice, M. Invernizzi, A. Ammendolia, Oxygen-ozone therapy for reducing pro-inflammatory cytokines serum levels in musculoskeletal and temporomandibular disorders: a comprehensive review, Int. J. Mol. Sci. 23 (5) (2022).

[4] D. Vanni, R. Galzio, A. Kazakova, A. Pantalone, A. Sparvieri, V. Salini, V. Magliani, Intraforaminal ozone therapy and particular side effects: preliminary results and early warning, Acta Neurochir. 158 (3) (2016) 491–496.

[5] D.S. Marín-Medina, J.H. Anzueta, A.P. Ortega-Quintero, J. Carrizosa, Severe complications after ozone therapy-related stroke, Clin. Neuroradiol. 34 (2) (2024) 511–514.

[6] F. Erroi, C. Rotondo, S. Sciacca, A. Trotta, F.P. Cantatore, A. Corrado, Serious spondylodiscitis, septic sacroiliitis and multiple abscesses after ozone therapy for low back pain: a case report on good response to combined treatment with empiric antibiotic and neridronate, Int. J. Rheum. Dis. 26 (8) (2023) 1590–1593.

[7] B. İlhan, H. Doğan, Novel complication of ozone therapy: massive emphysema and pneumomediastinum, Am. J. Emerg. Med. 41 (2021) 190–192.

[8] J.T. Ross, M.A. Matthay, H.W. Harris, Secondary peritonitis: principles of diagnosis and intervention, Bmj (2018) 361.

[9] A. Blaser, J. Starkopf, M. Malbrain, Abdominal signs and symptoms in intensive care patients, Anestezjol. Intens. Ter. 47 (4) (2019) 393–401.

[10] P. Estridge, J.A. Akoh, Recurrent spontaneous pneumoperitoneum: a surgical dilemma, Int. J. Surg. Case Rep. 30 (2017) 103–105.

[11] D. Miller, Tension pneumoperitoneum caused by obstipation, West. J. Emerg. Med. 16 (5) (2015) 777.

[12] R.A. Mularski, M.L. Ciccolo, W.D. Rappaport, Nonsurgical causes of pneumoperitoneum, West. J. Med. 170 (1) (1999) 41–46.

[13] M. Bedard, M. McInnis, K. Banton, Spontaneous pneumoperitoneum presenting as an acute abdomen, J. Surg. Case Rep. 2024(2):rjae049 (2024).
[14] A. Pinto, V. Miele, M. Laura Schillirò, M. Nasuto, V. Chiaese, L. Romano, G. Guglielmi, Spectrum of signs of pneumoperitoneum, Seminars in Ultrasound, CT and MRI 37 (1) (2016) 3–9.
[15] R. Tanaka, H. Kameyama, M. Nagahashi, T. Kanda, H. Ichikawa, T. Hanyu, T. Ishikawa, T. Kobayashi, J. Sakata, S.-i. Kosugi, et al., Conservative treatment of idiopathic spontaneous pneumoperitoneum in a bedridden patient: a case report, Surg. Case Rep. 1 (1) (2015) 69.
[16] H. Wang, V. Batra, Massive pneumoperitoneum presenting as an incidental finding, Cureus 10 (6) (2018).
[17] C. Sohrabi, G. Mathew, N. Maria, A. Kerwan, T. Franchi, R.A. Agha, The SCARE 2023 guideline: updating consensus Surgical CAse REport (SCARE) guidelines, Int. J. Surg. 109 (5) (2023) 1136–1140.
[18] S.H. Kim, Y.H. Cho, H.Y. Kim, Distinctive clinical features of spontaneous pneumoperitoneum in neonates: a retrospective analysis, World J. Clin. Cases 10 (23) (2022) 8124–8132.
[19] T.N. Tanner, B.R. Hall, J. Oran, Pneumoperitoneum, Surg. Clin. 98 (5) (2018) 915–932.
[20] S. Osman, B.E. Lehnert, S. Elojeimy, I. Cruite, L. Mannelli, P. Bhargava, M. Moshiri, A comprehensive review of the retroperitoneal anatomy, neoplasms, and pattern of disease spread, Curr. Probl. Diagn. Radiol. 42 (5) (2013) 191–208.
[21] P. Sergio, Abdominal cavity, peritoneum and retroperitoneum, in: L. Olivetti (Ed.), Atlas of Imaging Anatomy, edn, Springer International Publishing, Cham, 2015, pp. 129–135.
[22] J.S. Grewal, S. Mayer, J. Beaty, D. Formaro, J.S. Beaty, D.A. Formaro Jr., A rare case of spontaneous idiopathic pneumoperitoneum presenting as abdominal pain, Cureus 13 (5) (2021).
[23] F.N. Magalhaes, L. Dotta, A. Sasse, M.J. Teixeira, E.T. Fonoff, Ozone therapy as a treatment for low back pain secondary to herniated disc: a systematic review and meta-analysis of randomized controlled trials, Pain Physician (2012).
[24] F.J. Hidalgo-Tallón, L.M. Torres-Morera, J. Baeza-Noci, M.D. Carrillo-Izquierdo, R. Pinto-Bonilla, Updated review on ozone therapy in pain medicine, Front. Physiol. 13 (2022) 840623.