

Thoracoabdominal Trauma with Delayed Pneumoperitoneum: A Management Challenge

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ABSTRACT

Pneumoperitoneum typically indicates intra-abdominal hollow viscus perforation and more often than not requires emergency surgery. We report a rare case of delayed pneumoperitoneum following thoracoabdominal trauma without evidence of gastrointestinal perforation. A 39-year-old male sustained blunt thoracoabdominal trauma with Grade III-IV liver injury, multiple right rib fractures (3-7), and lung contusion. Delayed pneumoperitoneum developed 48 hours post-trauma without associated pneumothorax, subcutaneous emphysema, or pneumomediastinum. Conservative management was successful, avoiding unnecessary surgical intervention. Delayed pneumoperitoneum following thoracoabdominal trauma may occur through the Macklin effect without hollow viscus perforation. Clinical stability and careful monitoring can guide conservative management decisions.

Keywords: Pneumoperitoneum, Blunt Trauma, Thoracoabdominal Trauma, Macklin Effect, Conservative Management

Introduction

Pneumoperitoneum, defined as the presence of free air within the peritoneal cavity, occurs secondary to hollow viscus perforation in approximately 85-95% of cases. The remaining 5-15% result from non-gastrointestinal sources including thoracic injuries, gynecologic causes, idiopathic and miscellaneous causes.[1]. Blunt trauma can produce pneumothorax, pneumomediastinum, subcutaneous emphysema, and rarely, pneumoperitoneum [2] [3][4]. The Macklin effect, characterized by alveolar rupture with air dissection along peribronchovascular sheaths, may contribute to pneumoperitoneum in blunt trauma [3]. We present a case of polytrauma involving Grade III-IV liver injury with hemoperitoneum, multiple right-sided rib fractures (3-7), and lung contusion, complicated by delayed pneumoperitoneum developing 48 hours post-trauma without associated pneumothorax, subcutaneous emphysema, or pneumomediastinum.

Case Report

A 39-year-old male with no significant medical history presented following a motor vehicle accident with right chest pain, abdominal pain, and right-hand injury. Initial vital signs

revealed tachycardia (heart rate >120 beats per minute), blood pressure of 110/70 mmHg, and oxygen saturation of 88% on room air. Physical examination demonstrated decreased breath sounds in the right lower chest and upper abdominal tenderness with guarding. The patient was admitted to the surgical intensive care unit (SICU), where initial resuscitation included intravenous fluid administration, supplemental oxygen, tetanus prophylaxis, broad-spectrum antibiotics, and analgesic medications.

Laboratory investigations revealed elevated hepatic transaminases (alanine aminotransferase 532 U/L, aspartate aminotransferase 641 U/L) with otherwise normal routine blood parameters. Initial chest radiography demonstrated no pneumothorax or pleural effusion. (Fig.1a) Contrast-enhanced computed tomography (CECT) of the brain showed no evidence of traumatic brain injury. CECT of the chest revealed minimally displaced right-sided rib fractures (ribs 3-7), a left fifth rib fracture, bilateral minimal high-density pleural fluid, and lower lobe pulmonary contusion. Abdominal CECT demonstrated Grade III-IV liver trauma with extensive laceration involving segments V and IVb, accompanied by perihepatic subcapsular hematoma without active contrast extravasation, and high-density free fluid in perihepatic, perisplenic, and bilateral iliac fossa regions consistent with hemoperitoneum. (Fig.2a and 3a)

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Conservative management was implemented for both hepatic and thoracic trauma in consultation with pulmonologist. Serial hemoglobin monitoring remained stable throughout the initial hospital stay. On the second day post-admission, routine chest radiography revealed free air beneath the right hemidiaphragm. (Fig.1b) Repeat abdominal CECT demonstrated increased bilateral pleural fluid, intraparenchymal air within the contused liver parenchyma, and extensive pneumoperitoneum with large right subdiaphragmatic air collection and multiple peritoneal air loculi. (Fig.2b and 3b).

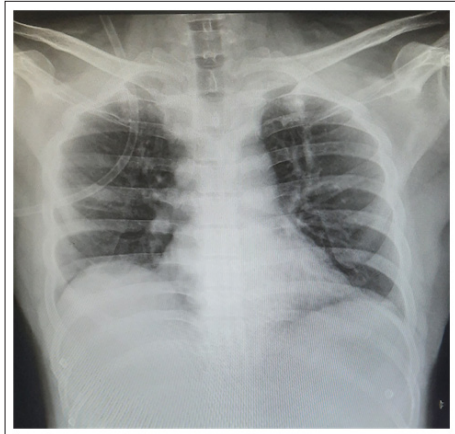


Figure 1A: X-Ray Chest at the Time of Admission



Figure 1B: X-Ray Chest After 36 Hour Showing Free Air Under Rt. Dome of Diaphragm

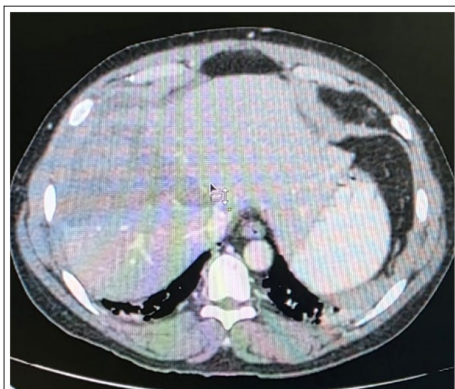


Figure 2A: Axial Image of Contrast Enhanced CT Scan of Abdomen at the Time of Admission Showing Hyperdense Lesion in Liver (Hematoma) with Perihepatic High Density Free Fluid (Hemoperitoneum)

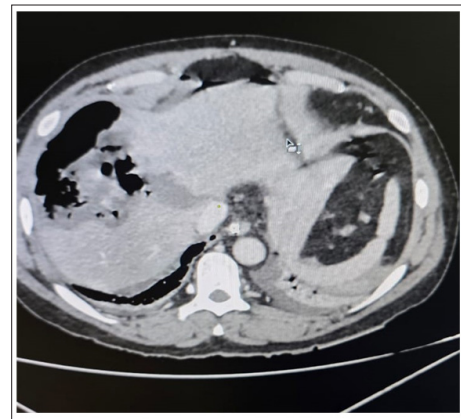


Figure 2B: CT Scan After 36 Hours Showing Free Air Free Fluid and Intra Parenchymal Air Pockets in Liver

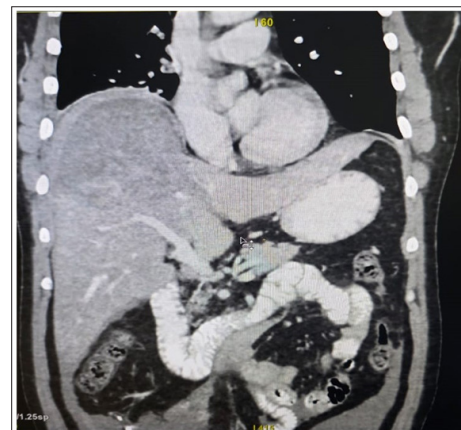


Figure 3A: Coronal Images of Contrast Enhanced CT Scan of Abdomen at the Time of Admission Showing Sub Capsular Hematoma in Liver and Free Fluid in Both Iliac Fossa

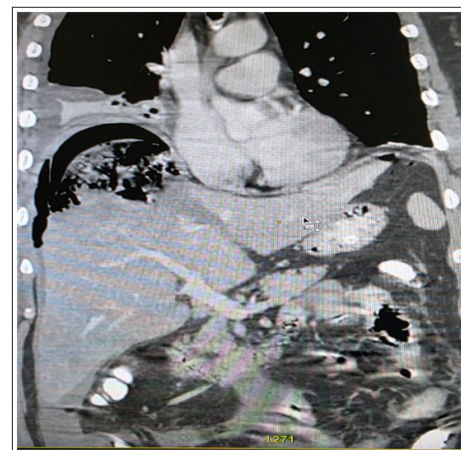


Figure 3B: CT Scan Image After 36 Hour Showing Free Air Below Rt. Dome of Diaphragm, Rt. Basal Collapsed Lung with Hemothorax and Intra Parenchymal air Pockets in Liver.

Despite radiographic findings suggestive of delayed hollow viscus perforation, the patient remained clinically stable without fever or leukocytosis. Ultrasound-guided peritoneal fluid aspiration yielded sanguineous fluid without enteric contents. A percutaneous drainage catheter was placed for continuous monitoring of intraperitoneal fluid characteristics. The patient was started on oral intake after 48 hours, once no clinical deterioration was observed. The patient was subsequently transferred from the SICU, successfully weaned from

supplemental oxygen, and discharged home. During outpatient follow-up, the patient developed fever and leukocytosis; repeat ultrasonography revealed an infected hematoma, which was successfully managed with ultrasound-guided drainage and antibiotic therapy.

This conservative management approach successfully avoided exploratory laparotomy, which could have increased perioperative risks due to general anesthesia in the context of concurrent chest trauma and potential mechanical ventilation needs.

Discussion

This case represents blunt thoracoabdominal trauma with an unusual presentation. Blunt hollow viscus injury is infrequent with incidence of hollow viscus and mesentery injury ranges from 3-5% with delayed or missed bowel injuries occurring in 10-30% of cases, significantly increasing mortality[5,8]. Beyond pneumoperitoneum, radiographic signs of bowel injury include free fluid, contrast extravasation, and bowel wall thickening [9,10]. Our patient demonstrated both pneumoperitoneum and free fluid, findings typically suggestive of hollow viscus perforation.

Multiple case reports describe pneumoperitoneum following blunt trauma, often accompanied by pneumothorax, pneumomediastinum or pneumoretroperitoneum [2,4]. We hypothesize that the rib fractures caused pulmonary parenchymal laceration, leading to pneumoperitoneum via the Macklin effect [2,11]. The Macklin effect describes alveolar rupture with subsequent air dissection along peribronchovascular sheaths toward the mediastinum and potentially into other anatomical compartments [2,11]. A microperforation of the diaphragm may have prevented the development of pneumothorax or pneumomediastinum while allowing air to enter the right subdiaphragmatic space and penetrate the liver capsule. This hypothesis is supported by the presence of major injuries on both sides of the diaphragm.

The pathophysiology of pneumoperitoneum without hollow viscus perforation often involves pressure gradients between thoracic and abdominal cavities [2,4]. Following alveolar rupture, air can track along peribronchovascular sheaths and eventually reach the peritoneal cavity through various anatomical pathways [2,4]. Clinical stability, absence of leukocytosis, and normal bowel function guided our conservative management approach.

The high-density free fluid observed on CECT suggested hemoperitoneum, which was confirmed through ultrasound-guided aspiration. The reflex was to subject the patient for laparotomy in view of pneumoperitoneum but by serial clinical examination, hemodynamically monitoring, laboratory and detail radiological assessment, patient could avoid unnecessary surgery [4,12]. This conservative approach aligns with emerging evidence supporting non-operative management in stable patients with pneumoperitoneum following blunt trauma. Patients of blunt trauma who underwent negative laparotomy have 33% more risk of mortality, when compared with positive laparotomy [7,14].

Conservative management of traumatic liver injuries has become increasingly accepted when based on hemodynamic stability rather than injury grade alone [15].

Conclusion

Pneumoperitoneum without hollow viscus perforation or positive pressure ventilation in thoracoabdominal trauma represents a rare clinical entity, with delayed presentations being even more uncommon. When chest radiography demonstrates pneumoperitoneum, computed tomography should be performed when clinically feasible to exclude intra-abdominal pathology. Although exploratory laparotomy remains the traditional response to pneumoperitoneum, judicious clinical decision-making based on hemodynamic stability, laboratory parameters, and detailed imaging findings can successfully avoid unnecessary surgical intervention. This case emphasizes the importance of recognizing the Macklin effect as a potential cause of pneumoperitoneum in thoracoabdominal trauma and supports selective conservative management in clinically stable patients.

References

1. Mularski RA, Sippel JM, Osborne ML. Pneumoperitoneum: a review of nonsurgical causes. *Crit Care Med.* 2000. 28: 2638-2644.
2. Alrahmani AA, Aldarsouni FG, Alwasel SL, AlGhamdi FS, Abdelhamid SW, et al. The Macklin effect following trauma: a case report of concurrent pneumothorax, pneumoperitoneum, pneumomediastinum, and pneumoretroperitoneum in an intubated young adult. *Cureus.* 2024. 16: e74901.
3. Hakim SY, Abdelrahman H, Mudali IN, El-Menyani A, Peralta R, Al-Thani H. Pneumoperitoneum in a patient with pneumothorax and blunt neck trauma. *Case Rep Surg.* 2014. 5: 1106-1109.
4. Curfman KR, Robitsek RJ, Sammett D, Schubl SD. Blunt trauma resulting in pneumothorax with progression to pneumoperitoneum: a unique diagnosis with predicament in management. *J Surg Case Rep.* 2015. 12: 1-4.
5. Watts DD, Fakhry SM. Incidence of hollow viscus injury in blunt trauma: an analysis from 275,557 trauma admissions from the EAST multi-institutional trial. *J Trauma.* 2003. 54: 289-294.
6. Özpek A, Türk E, Erdoğan S, et al. Hollow viscus injury due to blunt abdominal trauma: a tertiary trauma center experience. *Ulus Travma Acil Cerrahi Derg.* 2024. 30: 123-128.
7. Bège T, Brunet C, Berdah SV. Hollow viscus injury due to blunt trauma: a review. *J Visc Surg.* 2016. 153: 61-68.
8. Aljiffry MM, Bawazeer MA. A comparative analysis of conservative management and laparotomy in cases of free air after blunt abdominal trauma: A comprehensive case series investigation Saudi Surgical Journal. July-decemeber 2024. 12 (2): 84-86.
9. Soto JA, Anderson SW. Multidetector CT of blunt abdominal trauma. *Radiology.* 2012. 265: 678-693.
10. Atri M, Hanson JM, Grinblat L, Brofman N, Chughtai T, et al. Surgically important bowel and/or mesenteric injury in blunt trauma: accuracy of multidetector CT for evaluation. *Radiology.* 2008. 249: 524-533.
11. Wintermark M, Schnyder P. The Macklin effect: a frequent etiology for pneumomediastinum in severe blunt chest trauma. *Chest.* 2001. 120: 543-547.
12. Ahmad R, Mohamad N, Abdul Latiff AK. Pneumoperitoneum following blunt abdominal injury: does it warrant laparotomy?. *International Journal of Case Reports and*

- Images, Vol. 2 No. 1 2, December 201 1 . ISSN – [0976-31 98].
13. Renz BM, Feliciano DV. Unnecessary laparotomies for trauma: a prospective study of morbidity. J Trauma. 1995. 38: 350-356.
 14. Atkins K, Schneider A, Charles A. Negative laparotomy rates and outcomes following blunt traumatic injury in the United States. Injury. 2023. Aug;54 (8) 110894.
 15. Velmahos GC, Toutouzas KG, Radin R. Nonoperative treatment of blunt injury to solid abdominal organs: a prospective study. Arch Surg. 2003. 138: 844-851.