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Case Report

Simultaneous pneumothorax and pneumoperitoneum as a late consequence of traumatic injury of the diaphragm: Multimodality imaging approach with surgical correlation and treatment ☆

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ABSTRACT

Simultaneous occurrence of pneumothorax and pneumoperitoneum is a rare event, usually related to traumas or surgical procedures involving the diaphragm.

However, clinicians should be aware of the possible onset of these two clinical conditions even in patients without a recent clinical history that can clearly explain them.

Cross-sectional imaging techniques are of great importance, providing crucial information about the patient's clinical status and guiding the following patient management.

This work describes a unique case of a sudden occurrence of simultaneous pneumothorax and pneumoperitoneum in a previous asymptomatic man with a solely clinical history of minor trauma during childhood, evaluated through a multimodality imaging approach and treated with video-assisted thoracoscopy surgery.

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Introduction

Simultaneous occurrence of pneumothorax and pneumoperitoneum is a rare event.

The passage of air between thoracic and abdominal compartments is usually caused by recent traumatic injuries of the diaphragm or related to the presence of weakness points around esophageal-gastric anastomosis after surgical operations [1-3].

Up to now, only few cases have reported the concurrent manifestation of these two clinical entities in patients with specific diseases (ie, pleuroparenchymal fibroelastosis) or iatrogenic damages (ie, mechanical ventilation, gastro-esophageal anastomosis, aritificial pneumoperitoneum) [2, 4-6].

Nevertheless, diaphragmatic injuries constitute another uncommon complication of trauma (5%), especially related to motor vehicle accidents [7-9].

However, the coexistence of both these conditions without any recent positive clinical history is an emergency that has to be taken into account.

In any case, the role of radiological imaging is essential in detecting the consequences and in researching the original causes.

In particular, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) take advantage from the three-dimensional appraisal and the high spatial and contrast resolution.

The aim of this work is to report a unique case of sudden occurrence of simultaneous pneumothorax and pneumoperitoneum in a previous asymptomatic man with a solely clinical history of minor trauma during childhood.

Case report

A 26-year-old man complaining from left-chest pain with dyspnea and hypotension was admitted to a peripheral emergency department.

The patient reported a 10-year history of cigarette smoking, no comorbidities and only a minor motor vehicle trauma at the age of four, for which no hospitalization was needed.

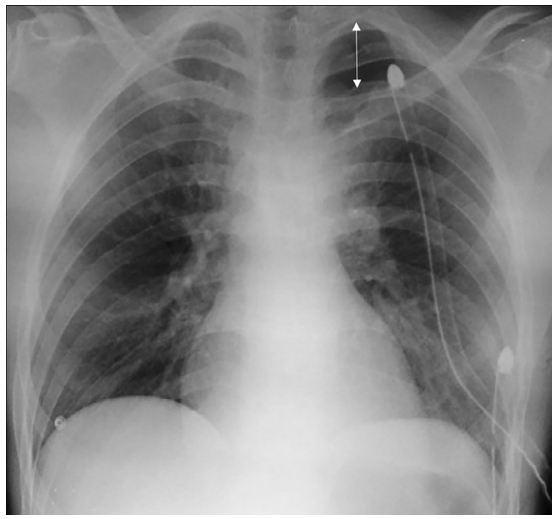

Fig. 2 – Chest x-ray performed on supine decubitus after chest tubes positioning. Pneumothorax is better appreciable within the left lung apex (arrows).

At clinical examination, decrease of breath sounds on the left side and bradycardia (45 bpm) were recorded. No abdominal tenderness or pain and no alterations of blood tests were found.

A chest x-ray plain film was performed, with detection of a wide tension pneumothorax within the left hemitorax and pneumomediastinum.

Due to the radiographic picture and the worsening of symptoms, the patient was transferred to our hospital.

Thus, a non-enhanced chest CT-scan was obtained with confirmation of the radiographic findings. Nevertheless, some small air bubbles were identified at the lower limit of the field of view, localized around the liver and the stomach. The scan was therefore extended to the abdomen, with detection of a small amount of pneumoperitoneum (Fig. 1).

Afterwards, 2 chest drainage tubes were placed (Fig. 2).

The following chest-abdominal CT-scan showed a volumetric decrease of the pneumothorax, with lung re-expansion and small ipsilateral pleural effusion. Moreover, a reduction in number and size of abdominal air bubbles was also appreciable (Fig.3).

Fig. 1 – Unenhanced CT-scan on coronal (A) and axial (B, C) planes. Pneumothorax on the left side (the double-head arrow indicates the major axis) as well as gas bubbles of pneumoperitoneum (arrowheads) and pneumomediastinum (arrow) are detectable. L: liver; H: heart; A: aorta.

Fig. 3 – CT-scan performed the day after hospitalization showed reduction in size of the left pneumothorax with residual small amount within the apical region of the left lung (black arrow).

In order to further investigate the underlying cause, an unenhanced MRI (Magnetic Resonance Imaging) of the diaphragm was performed. MRI better demonstrated a focal herniation of the second hepatic segment into the thoracic cavity, behind the left cardiac ventricle, with a diaphragmatic rupture extending approximately for 3-4 cm (Fig.4).

The patient underwent a video-assisted thoracoscopy surgery (VATS), which consisted in relocating the second hepatic segment into the abdominal cavity and in repairing the diaphragmatic damage through non-absorbable suture (Fig. 5).

After improvement of the clinical conditions, the patient was discharged. The follow-up chest x-ray performed approximately 50 days after initial hospitalization was unremarkable, according to the positive outcome of the surgical procedure (Fig. 6).

Discussion

Simultaneous occurrence of pneumothorax and pneumoperitoneum is a rare condition usually reported in patients with diaphragmatic leaks due to surgical operations or traumas [1, 3].

For what concern the latter, the underlying hypothesis includes an abrupt increase of intra-abdominal pressure which undermine the congenital diaphragmatic weakness points, consisting in the embryological “fusion areas” [10].

During a severe blunt trauma, the positive pressure gradient between the intraperitoneal and intrapleural pressures can exceed 100 cmH2O (normal values: 7-20 cm H2O) [11-12].

The consequences may include diaphragmatic leaks with intrathoracic herniation of abdominal organs [10].

The injury site is found on the left hemidiaphragm in 70%-80% of the cases, due to the protective effect of liver on the right side. In 5%-8% of the cases, the rupture is bilateral [13-14]

Patients may be asymptomatic for several years and diagnosis is usually delayed until complications arise.

In asymptomatic cases, clinical diagnosis is challenging, as confirmed by the relatively high rate of misdiagnosis (approximately 38%) [7].

Symptoms of diaphragmatic rupture include dyspnea, chest pain, loss of breath sounds over the affected hemithorax, cardiorespiratory failure as well as recurrent abdominal pain and obstructive gastrointestinal symptoms due to herniations [15].

Radiologic imaging is of the utmost importance in order to detect the cause and quantify the consequences.

X-ray plain film may show pneumothorax or pneumoperitoneum, but it is impaired by low sensitivity when present in small amounts. Moreover, it is rarely capable in demonstrating the original cause.

Therefore, CT-scan is considered the technique of choice in detecting diaphragmatic injuries, taking advantage from its high spatial resolution, multiplanar evaluation and concurrent wide appraisal of both the thoracic and abdominal compartments [10, 16].

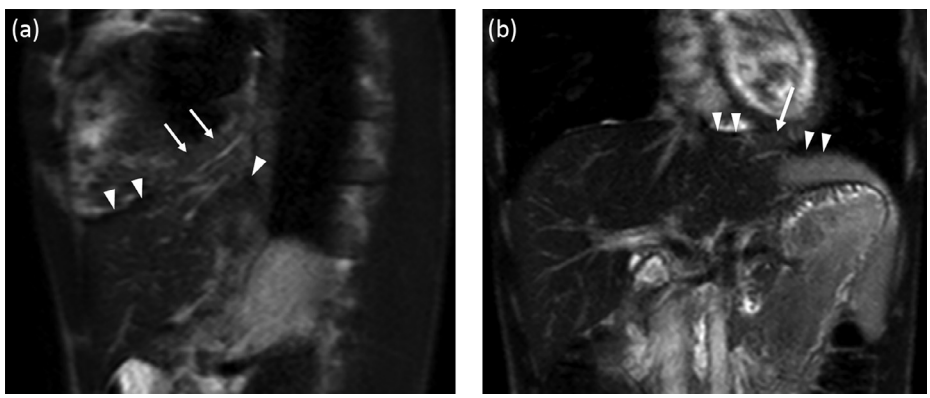

Fig. 4 – Unenhanced MRI. Sagittal (A) and coronal T2-weighted TSE with fat saturation (B) accurately show the diaphragmatic outline (arrowheads) focally interrupted with small herniation of the second hepatic segment (arrow).

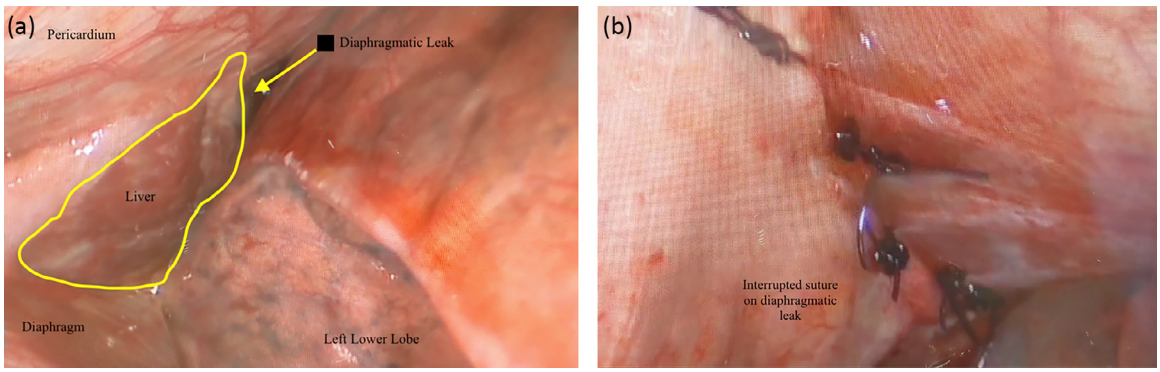

Fig. 5 – Intraoperative view during VATS. The diaphragmatic leak is visible at the level of the left cardiophrenic angle (A). The defect was then repaired through unabsorbable suture (B).

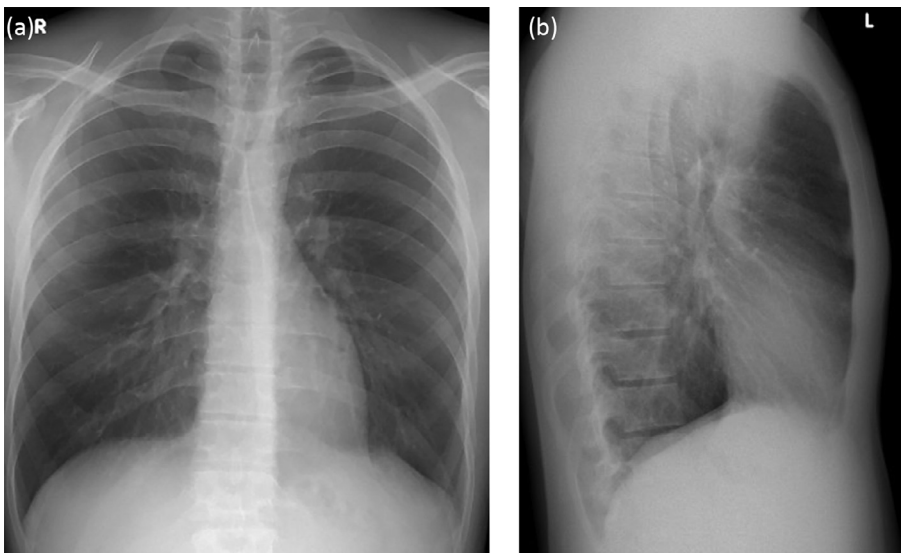

Fig. 6 – Follow-up chest x-ray on posteroanterior (A) and lateral (B) projections, performed 48 days after initial hospitalization, was unremarkable.

Nevertheless, MRI can be useful for diaphragmatic evaluation due to its superior soft tissue contrast resolution. Moreover, it can benefit from static or dynamic assessment without the need of radiation exposure [17-18].

In our case, the multimodality imaging evaluation led to a comprehensive assessment of the clinical picture with free air detection in the two cavities at CT-scan and accurate delineation of the diaphragmatic rupture at MRI.

In our opinion, the most probable cause was a weakening of the diaphragm at the level of second hepatic segment consequent to the trauma reported by the patient during childhood.

Traumatic rupture of the diaphragm is considered an indication for surgical repair, especially in symptomatic patients [19].

Suture is usually sufficient for diaphragmatic leak repair. In these cases, laparoscopic approaches are preferred, while thoracotomy is generally performed when large herniation of abdominal organs are also present [20-21].

Conclusion

Sudden occurrence of spontaneous pneumothorax and pneumoperitoneum is a rare condition, usually related to trauma or iatrogenic causes.

Achieving a correct diagnosis can be challenging in emergency cases, especially if not supported by a recent positive clinical history that can clearly explain it.

In this context, cross-sectional imaging techniques are of great importance, providing crucial information and guiding the following patient management.

Therefore, radiologists and clinicians should be aware of this clinical entity as well as the diagnostic possibilities of CT-scan and MRI in this field.

Patient consent statement

Informed consent was obtained by the patient.

This work was in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Declaration of Competing Interest

The authors declare they have no conflict of interest.

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