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Chronic right diaphragmatic defect and transient desaturation noted during laparoscopic appendectomy for acute appendicitis: A case report

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TITLE PAGE

Manuscript Title: Chronic right diaphragmatic defect and transient desaturation noted during laparoscopic appendectomy for acute appendicitis: A case report

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Abstract

Objective: To present the oxygen saturation drop observed during laparoscopic appendectomy in a patient with a probable chronic right diaphragmatic defect following trauma.

Materials and Methods: The clinical, imaging, operative, and available trauma records of a 27-year-old male patient with two days of abdominal pain were reviewed.

Results: Examination and computed tomography (CT) findings were consistent with acute appendicitis. Preoperative imaging revealed elevation of the right hemidiaphragm, displacement of the liver toward the right hemithorax, and compressive atelectatic changes in the right lower lobe. Prior trauma records described elevation of the right diaphragm and liver after the subsequent motorcycle accident. At laparoscopy, continuity of the right diaphragm was absent over a large portion, and the right lung and pericardium were reported to be visible above the liver. When the pneumoperitoneum pressure was reduced from 14 mmHg to 8 mmHg, oxygen saturation transiently rose above 90% and then tended to decline again. The appendectomy was completed, the pneumoperitoneum was evacuated, and no postoperative complications developed.

Conclusion: The possibility of a chronic traumatic diaphragmatic defect should be considered in patients with a history of trauma and diaphragmatic elevation on preoperative imaging. In this case, a temporal relationship was observed between the change in saturation and the pneumoperitoneum pressure; however, a causal relationship could not be definitively demonstrated.

Keywords: Acute appendicitis; laparoscopy; diaphragmatic defect; traumatic diaphragmatic injury; desaturation.

Introduction

Traumatic diaphragmatic rupture is an injury that may develop, particularly after high-energy blunt thoracoabdominal trauma, and may be missed in the acute phase. In blunt trauma, a sudden pressure change and an abrupt increase in intra-abdominal pressure can cause diaphragmatic tearing. If the injury is not recognized initially, abdominal organs may gradually migrate into the thoracic cavity over time, leading to the development of a chronic traumatic diaphragmatic hernia [1-3]. Right-sided injuries may be rarer and more difficult to diagnose, because of the protective effect of the liver and because it renders delineation of the diaphragmatic contour on CT more difficult [2].

Cases in which post-traumatic right diaphragmatic rupture was diagnosed years later have been reported. In one patient, a large right diaphragmatic defect, displacement of the liver and other abdominal organs into the thorax, and mediastinal deviation were identified several years after an old motor vehicle accident [3]. In another case, although rib fractures were present on the CT obtained at the time of trauma, no diaphragmatic injury could be demonstrated; a right hepatothorax was recognized 13 years later while the symptoms that had emerged were being investigated [4]. A case in which a right diaphragmatic hernia was detected 20 years after blunt trauma has also been published [5]. In addition, there are reports in adults in which complete or partial diaphragmatic agenesis or defect was detected or confirmed during laparoscopic cholecystectomy [6–8].

This report presents a patient in whom a chronic right diaphragmatic defect was thought to have developed after motorcycle accidents, and in whom the defect was visualized during laparoscopic appendectomy performed for acute appendicitis. The observation of a saturation drop during pneumoperitoneum is one of the clinical features that distinguishes this case from similar reports of traumatic hernias with delayed diagnosis.

Case Presentation

A 27-year-old male patient presented to the emergency department with abdominal pain that had persisted for two days. Physical examination revealed tenderness and rebound in the right lower quadrant. The leukocyte count was 22.71 × 10^9/L and the neutrophil count was 19.00 × 10^9/L. On contrast-enhanced CT, the appendiceal diameter measured 7.5 mm at its widest point; increased wall thickness and enhancement, increased density of the periappendiceal fat tissue, and a small amount of free fluid in the pelvis were observed. The findings were considered consistent with acute appendicitis.

The same CT showed that the right hemidiaphragm was elevated, that most of the hepatic dome was displaced toward the right hemithorax, and that there were compressive atelectatic changes in the right lower lobe (Figure 1).



Figure 1

The radiology report noted the possibility of a diaphragmatic hernia. The preoperative posteroanterior (PA) chest radiograph also showed an elevated right hemidiaphragm (Figure 2).



Figure 2

The patient's history included motorcycle accidents in November 2024. According to the trauma records, the CT obtained on 4 November 2024, before the subsequent accident, did not show diaphragmatic elevation; the images dated 27 November could not be obtained. On the subsequent evaluation, fracture lines in the right third and left seventh ribs, elevation of the right diaphragm and liver, and leftward deviation of the mediastinum were described. Bilateral hemopneumothorax was not detected. The diaphragmatic elevation was assessed as chronic. On history-taking, the patient stated that he was not aware of any pathology related to his diaphragm.

Laparoscopic appendectomy was planned. Approximately five minutes after the pneumoperitoneum was established at a pressure of 14 mmHg, oxygen saturation began to fall

rapidly. The appendix appeared consistent with acute appendicitis. Because the possibility of a diaphragmatic hernia had been noted on the preoperative CT, the camera was directed to the right upper quadrant. On laparoscopic examination, continuity of the right diaphragm was absent over a large portion (Figure 3); the margin of the defect was smooth and well defined. The surgical team reported that the right lung and pericardium were visible above the liver (Figure 4).



Figure 3



Figure 4

When the pneumoperitoneum pressure was reduced from 14 mmHg to 8 mmHg, oxygen saturation transiently rose above 90%; it subsequently tended to decline again. The appendectomy was completed, and the procedure was concluded with controlled evacuation of the pneumoperitoneum. The procedure was carried out in coordination with the anesthesia team. No postoperative complications developed. The patient was discharged after thoracic surgery recommendations had been obtained.

Discussion

The diagnosis of traumatic diaphragmatic rupture may be missed in the acute trauma period [1,2]; clinical findings may emerge weeks, months, or even years later [3,4]. Reports of delayed right-sided cases show that the liver or bowel may migrate into the thorax during this interval. In the case reported by Kesavaramanujam et al., a large right diaphragmatic defect, displacement of the liver into the thorax, and leftward mediastinal deviation were identified several years after an old motor vehicle accident [3]. Maldonado-Chaar et al. described a right hepatothorax 13 years later in a patient in whom no diaphragmatic injury was detected on the CT obtained at the time of trauma, despite the presence of lower rib fractures [4]. In the case of Senbu et al., a right diaphragmatic defect and bowel herniated into the thorax were observed 20 years after blunt trauma [5]. These cases show that diaphragmatic injury after trauma may remain asymptomatic for a long time and underscore the importance of comparison with prior imaging.

In the present patient, the absence of reported diaphragmatic elevation on the CT of 4 November 2024, obtained before the subsequent accident, together with the description of right diaphragmatic and hepatic elevation in the subsequent trauma evaluation, supports the possibility of an acquired defect. This chronology resembles that of the case in which diaphragmatic injury could not be demonstrated on the CT obtained at the time of trauma and which was diagnosed years later [4]. The data currently available suggest a chronic post-traumatic defect.

Preoperative CT reported elevation of the right hemidiaphragm, displacement of the liver toward the thorax, and compressive atelectasis in the right lower lobe. The absence of continuity over a large portion of the right diaphragm at laparoscopy, together with the report of the lung and pericardium being visible above the liver, is consistent with a distinct thoracoabdominal opening. This appearance may resemble that of laparoscopic cases in which complete or partial right hemidiaphragmatic agenesis was reported [6–8]; however, the patient's trauma history and imaging chronology also raise the possibility of an acquired traumatic defect. To determine the definitive etiology of the defect, radiological comparison of pre- and post-trauma images should be evaluated together with the surgical team's description.

The saturation drop that began approximately five minutes after the pneumoperitoneum was raised to 14 mmHg, resolved transiently when the pressure was reduced to 8 mmHg, and then tended to decline again illustrates the relationship between insufflation gas pressure and the pressure exerted on the lung. The recurrent decline in saturation may be explained by the pressure exerted by ventilation on the bronchi remaining lower than the insufflator pressure. Therefore, this observation should be presented not as a proven effect of pneumoperitoneum, but as intraoperative desaturation that emerged during pneumoperitoneum and showed transient improvement with pressure reduction.

Conclusion

The possibility of a chronic traumatic diaphragmatic defect should be considered in patients with a history of trauma and right hemidiaphragmatic elevation on imaging. Comparison of pre- and post-trauma images may help clarify the etiology. In this case, a saturation drop was observed during pneumoperitoneum; transient improvement was achieved with pressure reduction, after which the appendectomy was completed and the pneumoperitoneum was evacuated. In more complex cases we may not be as fortunate; therefore, the patient's physical examination, history, and radiological images should be reviewed in detail by the surgeon personally before the operation.

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