



Case report

Successful artificial pneumothorax thoroscopic repair of a right-sided diaphragmatic injury with hemothorax. A case report

Masaki Matsuda^{*}, Makoto Sawano

Department of Emergency and Critical Care Medicine, Saitama Medical Center, Saitama Medical University, 1981 Kamoda, Kawagoe-shi, Saitama-ken 350-8550, Japan

ARTICLE INFO

Keywords:

Diaphragmatic injury
Thoracoscopy
Right-sided
Hepatic injury
Hemothorax
Case report

ABSTRACT

Introduction and importance: Right-sided blunt diaphragmatic injury (BDI) is rare and often missed initially. Recently, some studies reported increased use of minimally invasive repair. A case of unexplained hemothorax that led to early suspicion of right-sided BDI, which was confirmed by exploratory thoracoscopy with an artificial pneumothorax, and primary repair was completed, is presented.

Case presentation: A 47-year-old woman had a moderate right hemothorax without rib fracture, vertebral fracture, or lung injury. A chest tube was inserted for the hemothorax, and approximately 470 mL of blood were evacuated initially. The right-sided BDI was not initially identified. Diagnostic thoracoscopy with an artificial pneumothorax confirmed diaphragmatic laceration. The liver was pushed back into the abdominal cavity with the use of the artificial pneumothorax. Primary closure of the diaphragmatic laceration was performed.

Clinical discussion: We must consider that a hemothorax without a lung injury or a chest wall injury may be a BDI. Thoracoscopy contributes to identifying and repairing a diaphragmatic injury. Additionally, an artificial pneumothorax provided a good operative field and spontaneously reduced the liver into the abdominal cavity, which facilitates the thoroscopic repair of BDI.

Conclusion: Unexplained hemothorax may be due to diaphragmatic injury, and exploratory thoracoscopy with an artificial pneumothorax may contribute to identifying and repairing a diaphragmatic injury.

1. Introduction

Blunt diaphragmatic injury (BDI) is rare, with an incidence of 0.8–8.0 % following trauma, especially a right-sided BDI, which is infrequent and often missed initially [1]. Delayed diagnosis and treatment are associated with increased rates of morbidity and mortality [2]. A case of unexplained hemothorax that led to early suspicion of right-sided BDI, which was confirmed by exploratory thoracoscopy with an artificial pneumothorax, and primary repair was completed, is presented.

The work was written in line with the SCARE criteria [3].

2. Presentation of case

A 47-year-old woman with no prior medical history was transferred to our hospital for definitive fixation of a pelvic fracture 4 h after a pedestrian accident. The previous regional hospital had transfused her

for hemodynamic instability, but on arrival at our hospital, she was already hemodynamically stable. She underwent whole-body, intravenous contrast-enhanced CT and was admitted to the Trauma Center Department in the same hospital. The CT report showed a subarachnoid hemorrhage, diffuse axonal injury, pelvic fracture, and hepatic injury with mild hemoperitoneum and right moderate hemothorax, but no pneumothorax, no rib fracture, and no vertebral fracture were detected (Fig. 1). In addition, the right hemothorax had expanded compared to the previous regional hospital's CT. The right-sided diaphragmatic injury was not initially identified. A chest tube was inserted for the hemothorax, and approximately 470 mL of blood were evacuated initially. Since there was neither lung injury nor chest wall injury, the suspected cause of hemothorax was bleeding from hepatic injury through the BDI.

Diagnostic thoracoscopy with an artificial pneumothorax was performed under general anesthesia with one-lung ventilation. A 12-mm port was inserted to the thoracic cavity, artificial pneumothorax was

Abbreviations: BDI, blunt diaphragmatic injury; CT, computed tomography.

^{*} Corresponding author at: Department of Emergency and Critical Care Medicine, Saitama Medical Center, Saitama Medical University, #303 4-27-13 Sembamachi, Kawagoe-shi, Saitama-ken 350-0034, Japan.

E-mail address: godfather5522@gmail.com (M. Matsuda).

<https://doi.org/10.1016/j.ijscr.2023.107913>

Received 5 January 2023; Accepted 1 February 2023

Available online 3 February 2023

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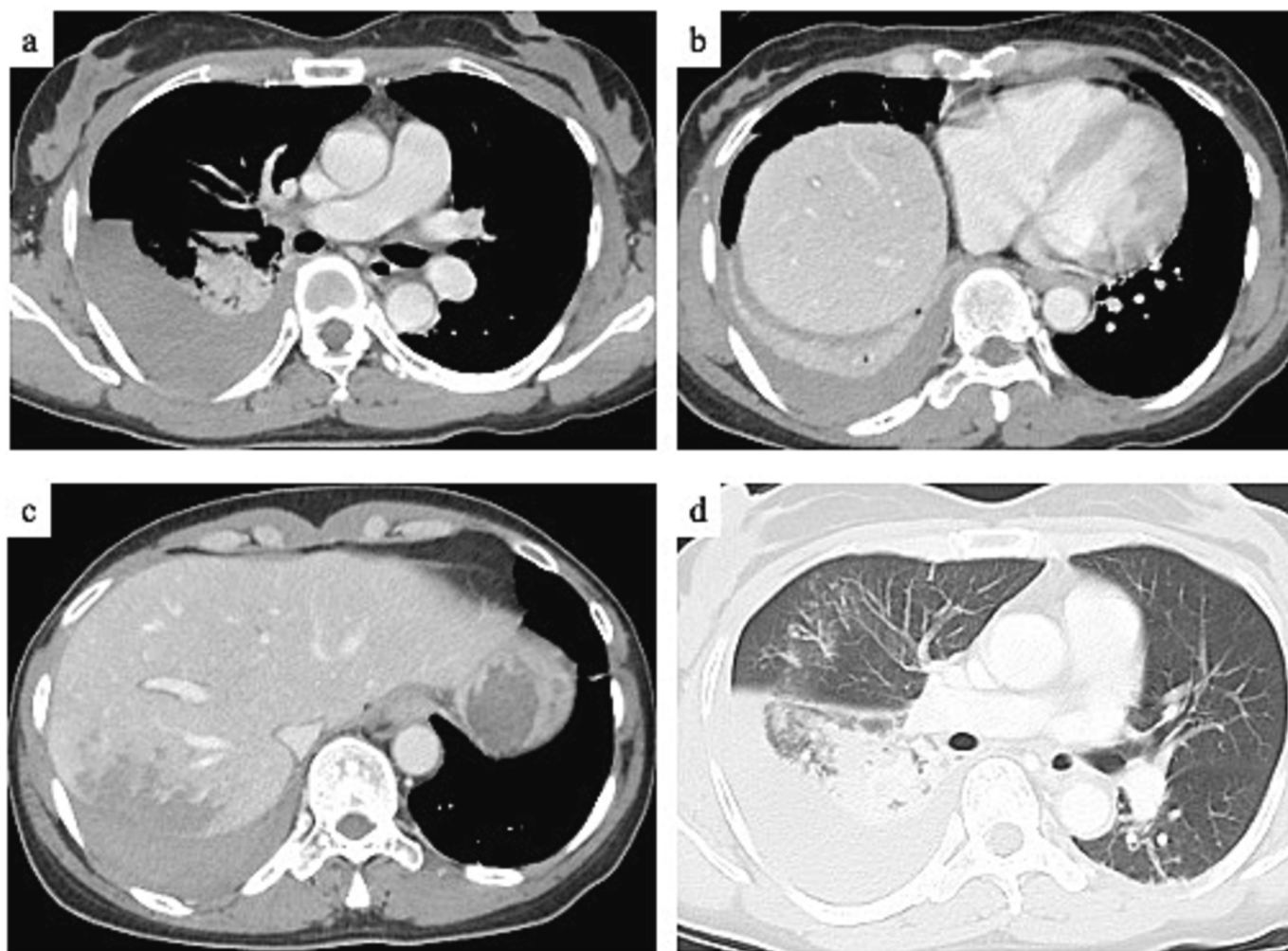


Fig. 1. Chest CT shows a moderate hemothorax, a hepatic injury with mild hemoperitoneum, and no pneumothorax.

established, and then another two ports were added. First, the retained hematoma was evacuated, and the thoracic cavity was observed. Intraoperative findings confirmed a diaphragmatic laceration of approximately 10 cm, and hepatic laceration through the diaphragmatic defect (Fig. 2). However, control of hepatic bleeding had already been achieved. The liver was pushed back into the abdominal cavity with the use of an artificial pneumothorax. Primary closure of the diaphragmatic laceration was completed with 2–0 V-Loc™ (Fig. 3). Operative time was 64 min, and total blood loss was slight. The patient had an uneventful postoperative course.

3. Discussion

This case highlights two important clinical issues. An unexplained hemothorax could be a possible BDI, and thoracoscopic repair with artificial pneumothorax is effective for a BDI with hemothorax.

First, an unexplained hemothorax could be a possible BDI. With the advances in CT technology, 75 % of BDIs are diagnosed within 24 h of injury [4], but right-sided rupture was a common cause of delayed diagnosis [5], which can remain unrecognized for weeks or even years [4]. Ebrahimi et al. reported a case with right diaphragmatic rupture after blunt injury 31 years prior to admission [6]. Since delayed or missed diagnoses may place patients at risk of morbidity and mortality [5], early diagnosis is important. In the present case, an unexplained hemothorax led to an early diagnosis. Most hemothoraces are caused by

lung injury or chest wall injury, so a massive hemothorax due to diaphragmatic injury is rare [7]. We must consider that a hemothorax without a lung injury or a chest wall injury may be a BDI.

Second, thoracoscopic repair with artificial pneumothorax is effective for a BDI with hemothorax. Although the majority of BDIs were repaired with open techniques, some studies reported increased use of minimally invasive repairs [8–10]. There is no consensus in the literature on the recommended surgical approach [4]. Choosing thoracoscopy versus laparoscopy depends on the surgeon's skillset, stability of the patient, and indications [9]. In particular, the majority of BDIs with hemothorax were traditionally repaired via laparotomy or thoracotomy [7,11]. There may be more cases where thoracoscopic repair for BDI with hemothorax is feasible. In addition, thoracoscopic repair with artificial pneumothorax has never been previously reported. An artificial pneumothorax has recently been used frequently in esophageal surgery or mediastinal surgery. Insufficient lung collapse in one-lung ventilation associated with pulmonary contusions and thoracic deformity often results in poor operative fields in thoracoscopic trauma surgery. Consequently, we have routinely used artificial pneumothorax for thoracoscopic trauma surgery. In the present case, an artificial pneumothorax provided a good operative field and spontaneously reduced the liver into the abdominal cavity, which facilitates the thoracoscopic repair of BDI.

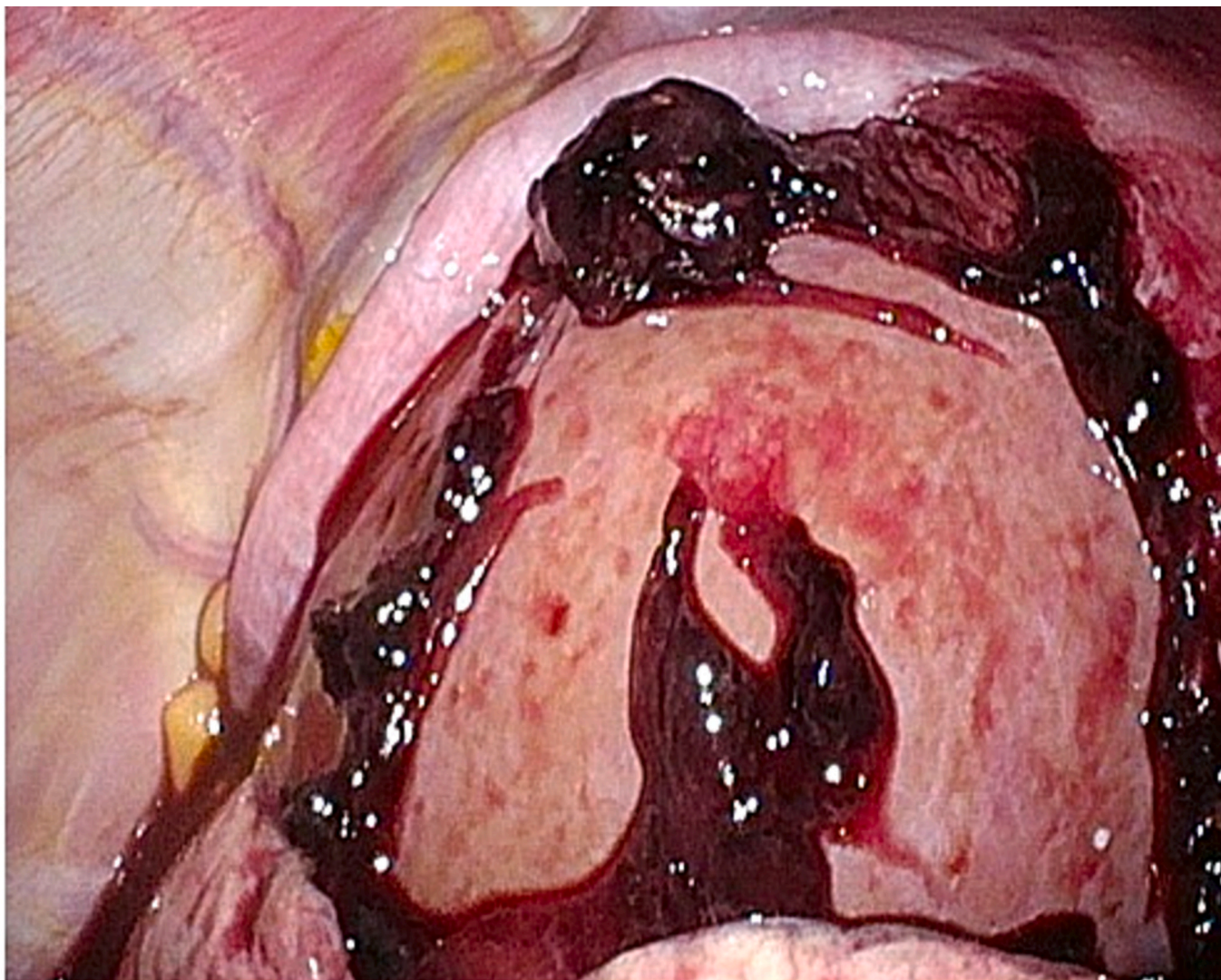


Fig. 2. Thoracoscopic view shows a diaphragmatic laceration and the liver.

4. Conclusion

Unexplained hemothorax may be due to diaphragmatic injury, and an exploratory thoracoscopy with an artificial pneumothorax may contribute to identifying and repairing a diaphragmatic injury. Further reports need to be accumulated to clarify the relationship between unexplained hemothorax and diaphragmatic injury and whether exploratory thoracoscopy with an artificial hemothorax may contribute to identifying and repairing a BDI.

Patient consent

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

Ethical approval

Ethical Approval was waived by the authors institution.

Funding

There were no sponsors for this case report.

Guarantor

Makoto Sawano.

Research registration number

N/A.

CRediT authorship contribution statement

Masaki Matsuda: Conceptualization, Writing.
Makoto Sawano: Supervision.

Conflicts of interest

The authors declare they have no conflicts of interest.

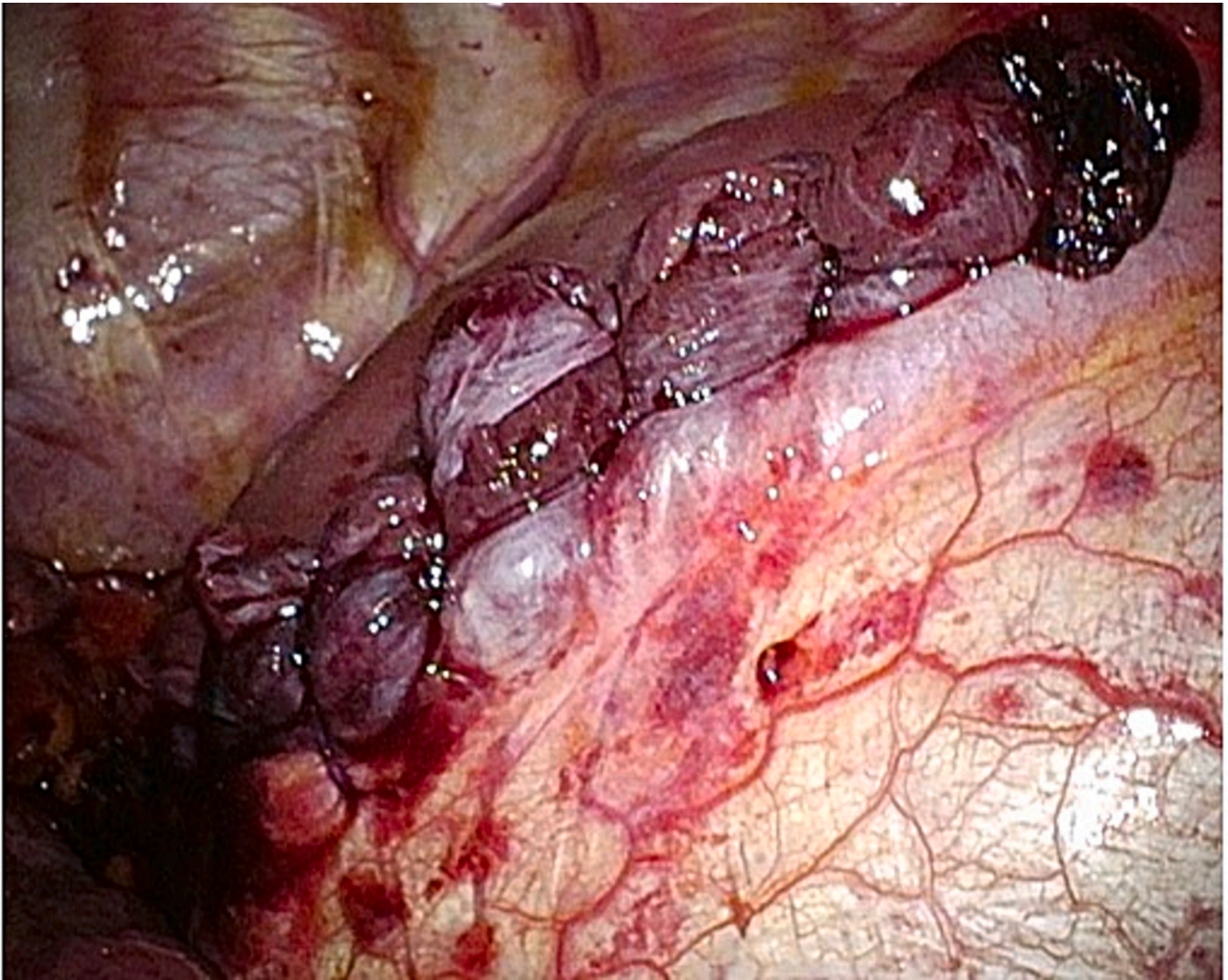


Fig. 3. Post-repair diaphragm.

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