

CASE REPORT

TRAUMATIC DIAPHRAGMATIC RUPTURE WITH VISCERAL HERNIATION: A CASE REPORT

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Herniation***ABSTRACT**

Background: The diaphragm is a dome-shaped respiratory muscle located near the lower ribs; the exact location is below the chest. Diaphragmatic rupture is a medical condition caused by blunt or penetrate trauma, which often leads to herniation of the abdominal viscera into the thoracic cavity.

Case: We presented a case in which a 39-year-old man complained of left chest pain and abdominal pain radiated to his back, after involved in a traffic accident. On physical examination, the left chest was left behind when breathing, a dull sound was found on percussion, with diffuse abdominal tenderness. Thoracal Abdomen CT-scan was performed, and it concluded that there was a rupture of the left posterior diaphragm with a diameter of 15 cm which caused herniation of the gastric and intestines to the left of thoracic cavity, accompanied by a collapse of the left lung due to blunt trauma. The patient underwent an explore laparotomy with the aim of repairing his diaphragmatic rupture, and splenectomy procedure to remove the affected spleen.

Conclusion: Surgery is a mandatory action in order to repair the diaphragm. The choice of the approach to be used, either laparotomy or thoracotomy depends on other organ abnormalities, acute or latent cases, stable or unstable condition of the patient and depends on the experience of the operator.

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INTRODUCTION**Background**

Diaphragmatic rupture is a medical condition caused by blunt or penetrating trauma and often results in herniation of the abdominal viscera into the thoracic cavity (1). The diaphragm develops from the pleuroperitoneal membrane and body wall, the

dorsal mesentery of the oesophagus and the septum transversum from the embryo (2). Traumatic diaphragmatic injury (TDI) occurs in 1% of patients of blunt abdominal trauma (3).

The incidence of trauma-induced diaphragmatic rupture is 1 to 7% of all patients with blunt trauma, and 10-15% with

penetrating injuries. Diaphragmatic rupture due to trauma is usually associated with multiple injuries because of the large forces resulting rupture of the diaphragm (1)(4). Acute diaphragm injuries are best approached through the abdomen (5).

The pathophysiology of this injury remains unclear up to this date, but the most accepted hypothesis has described, an increase of intra-abdominal pressure followed by a blunt trauma mechanism which creates a high-pressure gradient between chest and abdomen can cause visceral intrathoracic rupture and herniation.(6)(7) Normally, there is a positive gradient of 7–20 cmH₂O between intraperitoneal and intrapleural pressures, but during blunt injuries this pressure gradient can exceed 100 cmH₂O and this can lead to rupture and herniation (8)(7).

The physical examination often fails to identify a traumatic diaphragmatic rupture and basic investigations such as a chest X-ray may miss half the time. Although not part of the standard FAST (focused assessment with sonography for trauma) ultrasound scan in trauma, bedside ultrasound has the potential to detect pathology of a ruptured diaphragm (9).

There are no specific signs and symptoms to diagnose a diaphragmatic rupture. A high level of clinical suspicion is required in all cases of thoraco-abdominal injury to diagnose diaphragmatic rupture. Computed Tomography (CT) of the chest and abdomen is very useful in the diagnosis of this patient case. If there is any doubt, diagnostic laparoscopy should be performed to confirm the diagnosis to reduce mortality and morbidity (10).

Diagnostic techniques included X-Ray, Computed Tomography, and Intraoperative findings. Clinical diagnosis is relatively difficult because the signs found are like other disorders. The signs and symptoms that appear are pain in the chest and abdomen, also respiratory problems. When rupture is found, an operation is required to repair it (11).

The best management for patients with diaphragmatic rupture is surgery. No cases of diaphragmatic rupture have been found to heal spontaneously. This happens because of the difference in pressure between the abdominal cavity and the thoracic cavity, causing a slight rupture of the diaphragm, herniation of the abdominal organs will occur into the thoracic cavity(12) Surgery can be performed either through the thorax (thoracotomy) or abdomen (laparotomy). There are no studies on which type of surgery is considered the best course of action for patients with diaphragmatic rupture, to date (2).

A case report presents a patient with a visceral herniation, detected 5 years after pneumonectomy for non-small cell lung cancer surgery with a diaphragmatic muscle flap supported on the bronchial stump. The patient underwent emergency thoraco-laparotomy 9 years after the first operation due to acute abdominal symptoms. This is the first reported case of a late period visceral disc herniation that improved after surgery (13).



Figure 1. Whole-body non-contrast CT scan (scout view): detection of left-sided posterior diaphragmatic hernia involving visceral herniation and hemothorax.

Case Presentation

A 39-year-old man admitted to hospital accompanied by his family, he complained pain in his left chest and abdominal pain that radiated to his back after experiencing a traffic accident one hour ago. The patient said that he had driven a motorcycle and hit the car in front of him, then fell to the left, the patient was not wearing a helmet. The patient came with GCS 15 consciousness, respiratory rate 20 breaths per minute and blood pressure 113/70 mmHg.

On physical examination, it was found that the left chest was left behind when breathing, a dull sound was obtained on percussion, with diffuse abdominal tenderness, but no signs of peritonitis were found. From the results of the plain chest X-ray, it was found that the left hemithorax was covered with elevation of the diaphragm with 7,8,9 rib fractures.

Focused assessment with CT-Scan Thoracoabdominal and concluded that there was a rupture of the left posterior diaphragm with a diameter of 15 cm which caused herniation of the gastric and intestines into the left thoracic cavity with collapse of the left lung due to blunt trauma due to a traffic accident. The patient also suffered several other traumatic injuries, including multiple left rib fractures, left hemothorax, left lower lobe pulmonary contusion, and 5th degree of splenic laceration.



Figure 2. CT scan showed diaphragmatic rupture and intrathoracic bowel herniation.

The patient had undergone an exploratory laparotomy to repair the ruptured diaphragm and had a splenectomy procedure performed to remove the damaged spleen. Intraoperatively, the stomach and intestines were returned to the abdominal cavity and the diaphragm was sutured with interrupted sutures using non-absorbable sutures on the ruptured side of the diaphragm on the left posteriorly. No gastric ischemia or perforation was found.

All the intra-abdominal organs and the left lung were intact. The operation was carried out for 3 hours. The patient was placed on a chest tube with left intrapleural Water Sealed Drainage (WSD) and an intra-abdominal drain on the left sub diaphragm. The patient eventually recovered and was discharged after 2 weeks of hospitalization. At 2 weeks after follow-up the patient was in good condition.

Discussion

The diaphragm is a dome-shaped respiratory muscle located near the bottom of

the rib cage, just below the chest (4). The actual incidence of diaphragmatic rupture is difficult to ascertain because the diagnosis is usually missed and delayed, ranging from 1 to 7% of all blunt trauma patients, and 10 -15% with penetrating injuries, and this number is expected to increase due to the increasing number of traffic accidents each year. The most common causes of blunt injuries are high-speed traffic accidents and penetrating injuries are knife attacks and gunshot wounds (1).

Penetrating or blunt trauma to the chest and abdomen can cause diaphragmatic rupture, is usually associated with multiple injuries because great force is required to rupture the diaphragm and is usually fatal. A high index of clinical suspicion is necessary to diagnose and effectively manage diaphragmatic rupture even with a distant history of high-velocity injury. This is especially the case when there are other signs of severe trauma such as multiple rib fractures, lacerations of the liver and spleen, or a history of deceleration injuries (14).

A significant complication of diaphragmatic rupture is a traumatic diaphragmatic hernia; Organs such as the stomach that enter the thoracic cavity can become strangled and cause ischemic herniation of the abdominal organs which occurs in 3-4% of abdominal trauma patients presenting to the trauma center (15). The most frequently herniated organs on the left side are the stomach (80%), omentum, small intestine, large intestine, and spleen (1). This is because these organs are structurally weak because they are pleuroperitoneal membranes. Diaphragmatic rupture on the left is more common than on the right because of the protective effect of the liver, underdiagnosis of right hemidiaphragm rupture and weak location of the left hemidiaphragm due to embryonic fusion (2).⁴ Diaphragmatic rupture following blunt trauma generally results in a wider wound than that caused by penetrating trauma has a size of about 5-15 cm.

Initially most cases of diaphragmatic rupture are often overlooked especially in the acute phase because of other associated injuries. Diagnosing diaphragmatic rupture is often difficult to establish and easily missed due to non-specific signs and findings (11). Neglected diagnosis of diaphragmatic rupture injury which eventually presents as a hernia which can appear years later with potentially fatal complications. Delayed diaphragmatic rupture and diaphragmatic hernia should be considered in patients with blunt abdominal trauma and gastrointestinal or respiratory complaints, especially patients with a history of recent trauma (16).

Detection may be delayed if the diaphragmatic tear remains asymptomatic at the time of injury and manifests only in the presence of a hernia. Delayed rupture can occur if diaphragm tissue is damaged at the time of injury but maintains a weak barrier until several days later when excessive inflammation weakens it (17). Less traumatic cases and smaller diaphragmatic ruptures are associated with a delay in diagnosis. Thoraco-abdominal computed tomography scanning is necessary for patients with peripheric injuries to avoid delaying the diagnosis of TDH. Increased awareness and understanding of diaphragmatic injuries will increase the early diagnosis rate and improve the prognosis (18).

Diaphragmatic rupture is usually treated by laparotomy. The most common therapeutic approaches for diaphragmatic rupture are thoracotomy or laparotomy. At laparotomy, regardless of whether the diagnosis is suspected or confirmed preoperatively, a full evaluation of both diaphragms should be carried out, and consideration should also be given to other injuries such as a haemothorax that may arise and are more urgent to treat first if there is a rupture of the diaphragm. All herniated viscera should be carefully returned and moved to their original position (1)(8). The diaphragmatic

tissue is carefully repaired using non-absorbable monofilament sutures. In some cases, complicated by adhesions and extensive defects, MESH is sometimes required to help manage the defect (4)(16).

The American Association for Trauma Surgery (AAST) Organ Injury Scaling Committee proposes a classification system for diaphragmatic injuries: Grade 1 contusions; Grade 2 laceration <2cm; Grade 3 lacerations 2–10 cm; Grade 4 laceration >10 cm or with tissue loss <25 cm²; and Grade 5 laceration with tissue loss >25 cm².^{7,8} According to this classification system, our patient's case was a grade 4 diaphragmatic injury.

Treatment for an injured diaphragm is operative whether the injury is acute or chronic, the acute injury can usually be repaired first. Improvement can be achieved via laparoscopy or laparotomy, depending on the hemodynamic stability of the patient and the associated injury. In the patient with chronic trauma-related diaphragmatic hernia, a careful history and physical examination may be suggestive (19).

In multitrauma patients with diaphragmatic rupture as in our case, patient survival is determined by the severity of the associated injury, timely diagnosis, and early intervention (6). Although diaphragmatic rupture is still difficult to diagnose in trauma patients, a high index of suspicion with the use of appropriate radiological modalities helps in arriving at a correct diagnosis. Emergency surgical repair should be performed as soon as possible to reduce morbidity and mortality (20).

In this regard, our patient had undergone a CT-Scan with clinical evaluation as the main determining factor for deciding on exploratory surgery. CT Scan is more accurate in establishing the diagnosis compared to X-ray, another diagnostic method that has been carried out is by laparotomy, but in 15% of cases of diaphragmatic rupture it is missed.

Trauma to the diaphragm is often discovered incidentally during laparotomy for other organ injuries. Thoracoscopy is preferred over laparotomy especially for detecting chronic diaphragmatic hernias (11).

In chronic cases, repair may be difficult or even impossible. Delay in detecting and repairing diaphragmatic rupture can increase morbidity and mortality. A significant complication of diaphragmatic rupture is traumatic diaphragmatic hernia, where organs such as the gastric that have entered thoracic cavity can strangulate and cause ischemia (11)(16). Recommends the collection of information that is not limited to index hospitalization and type of trauma to better determine the diagnosis of the disease (8).

CONCLUSION

Diaphragmatic rupture should be suspected in all trauma patients, especially if they have blunted abdominal and lumbar trauma. High suspicion with detailed information about the mechanism of injury and the use of appropriate diagnostics are the most important factors in establishing the correct early diagnosis of diaphragmatic rupture. There is a differential diagnosis of diaphragmatic rupture in adult patients with upper abdominal symptoms or chest X-ray depicting diaphragmatic elevation, therefore it is necessary to ask whether there is a history of trauma, whether it occurred a few days ago or years ago. If no abnormalities are found, serial chest X-rays and high-quality CT scans in stable patients can be performed to diagnose diaphragmatic rupture and other abnormalities in the thoracic and abdominal organs.

Surgery is a mandatory action to repair the affected diaphragm. The management approach can be in the form of laparotomy, thoracotomy, and laparoscopy which is determined from the acute or latent case, stable

or unstable patient condition, and operator experience. In most cases, repaired diaphragmatic rupture has a good prognosis. The mortality rate is around 15-40% but the presence of other organ injuries plays a major role in determining the prognosis.

CONFLICT OF INTEREST

All authors declared that there is no conflict of interest related to the publication of this article.

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REFERENCES

- Mindaye ET, Zegeye A. Massive left hemothorax following left diaphragmatic and splenic rupture with visceral herniation: A case report. *Int J Surg Case Rep* [Internet]. 2021;78:4–8. Available from: <https://doi.org/10.1016/j.ijscr.2020.11.144>
- McDonald AA, Robinson BRH, Alarcon L, Bosarge PL, Dorion H, Haut ER, et al. Evaluation and management of traumatic diaphragmatic injuries: A Practice Management Guideline from the Eastern Association for the Surgery of Trauma. *J Trauma Acute Care Surg*. 2018;85(1):198–207.
- Lee MA, Choi KK, Lee GJ, Yu BC, Ma DS, Jeon Y Bin, et al. Right Diaphragmatic Injury Accompanied by Herniation of the Liver: A Case Report. *J Trauma Inj*. 2016;29(2):43–6.
- Mahmoud AF, Eldin Raeia MM, Abo Elmakarem MA. Rupture diaphragm: Early diagnosis and management. *J Egypt Soc Cardio-Thoracic Surg* [Internet]. 2017;25(2):163–70. Available from: <http://dx.doi.org/10.1016/j.jescts.2017.05.003>
- Shah R, Sabanathan S, Mearns AJ, Choudhury AK. Traumatic rupture of diaphragm. *Ann Thorac Surg*. 1995;60(5):1444–9.
- Furák J, Athanassiadi K. Diaphragm and transdiaphragmatic injuries. *J Thorac Dis*. 2019;11(3):S152–7.
- Shaban Y, Elkbuli A, McKenney M, Boneva D. Traumatic diaphragmatic rupture with transthoracic organ herniation: A case report and review of literature. *Am J Case Rep*. 2020;21:1–7.
- Mahamid A, Peleg K, Givon A, Alfici R, Olsha O, Ashkenazi I. Blunt traumatic diaphragmatic injury: A diagnostic enigma with potential surgical pitfalls. *Am J Emerg Med*. 2017;35(2):214–7.
- Tjhia J, Noor JM. Beyond E-FAST scan in trauma: Diagnosing of traumatic diaphragmatic rupture with bedside ultrasound. *Hong Kong J Emerg Med*. 2018;25(3):163–5.
- Kishore A, Singh A, Jain A. Traumatic diaphragmatic hernia: a case report. *Int Surg J*. 2018;5(6):2378–82.
- Iadicola D, Branca M, Lupo M, Grutta EM, Mandalà S, Cocorullo G, et al. Double traumatic diaphragmatic injury: A case report. *Int J Surg Case Rep*. 2019;61:82–5.
- Amaliah R. Diagnosis dan Tatalaksana Ruptur Diafragma pada Fase Akut dan Fase Laten. *JBN (Jurnal Bedah Nasional)*. 2020;4(1):26.
- Ayalp K, Kaba E, Demirhan Ö, Özyurtkan MO, Toker A. A late visceral hernia after diaphragmatic flap coverage of the bronchial stump. *J Thorac Dis*. 2015;7(7):E198–200.
- Rashid F, Chakrabarty MM, Singh R, Iftikhar SY. A review on delayed presentation of diaphragmatic rupture.

- World J Emerg Surg. 2009;4(1):1–7.
15. Sejati F. Hernia Diafragma terkait dengan Pasien Ruptur Diafragma Traumatik: Laporan Kasus. *J Innov Res Knowl*. 2022;3471(10):1212–24.
 16. Kishore GSB, Gupta V, Doley RP, Kudari A, Kalra N, Yadav TD, et al. Traumatic diaphragmatic hernia: Tertiary centre experience. *Hernia*. 2010;14(2):159–64.
 17. Dwari AK, Mandal A, Das SK, Sarkar S. Delayed Presentation of Traumatic Diaphragmatic Rupture with Herniation of the Left Kidney and Bowel Loops. *Case Rep Pulmonol*. 2013;2013(Figure 1):1–4.
 18. Gu P, Lu Y, Li X, Lin X. Acute and chronic traumatic diaphragmatic hernia: 10 years' experience. *PLoS One*. 2019;14(12):1–9.
 19. Jain SA. Traumatic Diaphragmatic Hernia. *J Surg*. 2018;2018(01):2012–3.
 20. Kuppusamy A, Ramanathan G, Gurusamy J, Ramamoorthy B, Parasakthi K. Delayed diagnosis of traumatic diaphragmatic rupture with herniation of the liver: A case report. *Ulus Travma ve Acil Cerrahi Derg*. 2012;18(2):175–7.