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Non-Operative Management in Crural Hematoma after Blunt Diaphragmatic Injury: A Case Report

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Introduction

Background

Diaphragmatic injury is a relatively uncommon complication in 1-8 % of blunt trauma **[1-4]** and 10-15 % of penetrating trauma **[1]**. In more recent and broader studies, the incidence of direct diaphragmatic injury (BDI) is even lower (< 1 %) **[5,6]**. Blunt trauma is associated with traffic accidents in 90 % of cases, while penetrating trauma is mainly related to gunshot and stab wounds **[7,8]**. Penetrating trauma is responsible for > 60 % of cases of diaphragmatic injury **[3.7.9]**. The left hemidiaphragm is affected up to three times more than the right side due to the protective effect of the liver, the congenital weakness of the posterolateral left side **[2,8]**, and the more frequent right-handed nature of the aggressor in case of stab wounds **[9]**.

Compared to penetrating trauma, BDI has higher mortality rates because it is usually associated with higher Injury Severity Scores (ISS), significant defects (5-15 cm), and other organ lesions **[5,9,10]**. When the right diaphragm is affected, the mortality is also statistically higher because of the energy needed and the subsequent increase in intraabdominal pressure and secondary injuries **[1,9]**.

The presentation of a high-energy blunt trauma with an isolated hematoma on the diaphragmatic crus without any other intraabdominal lesions is very uncommon, with only two previously reported cases to our knowledge **[2,11]**.

Case Presentation

A 75-year-old woman on oral anticoagulation therapy for chronic atrial fibrillation was brought to the Emergency Department after a motor vehicle collision with blunt thoracoabdominal trauma. During the primary revision, the patient was hemodynamically stable, with a 95 % oxygen saturation level, and only referred to bilateral chest pain. Thorax was structurally sound, without costal volet. Laboratory tests showed isolated leukocytosis without anemia and a prolonged International Normalized Ratio. Chest and abdominal radiography showed bilateral rib fractures with no other findings. CT-scan confirmed the presence of symmetric bilateral rib fractures (from 3rd to 7th), a dubious sternal fracture, mild pericardial effusion, and a thickening of the right diaphragmatic crus with contrast extravasation suggesting intramuscular hematoma with active bleeding **(Figure 1)**. No other injuries were identified.

We started non-operative management (NOM) with parenteral analgesia, including transdermic fentanyl, NSAIDs, gastroprotection, suspension of oral anticoagulation, and serial hemoglobin and hematocrit measurements. The patient was controlled in the ICU for 24 hours without respiratory or hemodynamic compromise. After a twelve-day hospitalization and a control CT scan showing a decrease in the diaphragmatic hematoma with no other previously unidentified injuries, the patient was discharged with painkillers, rehabilitation, and a follow-up with radiological control in two months.

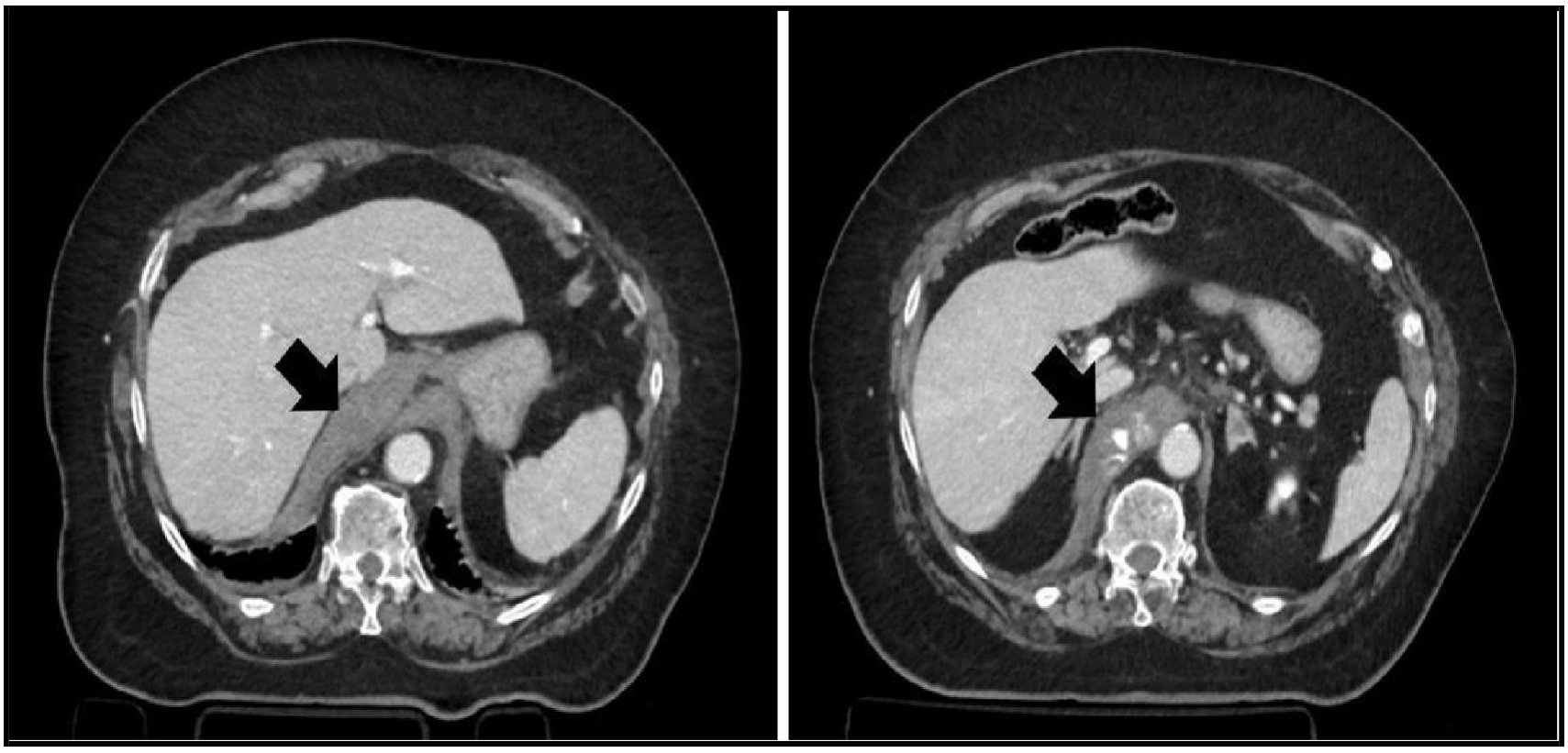

Figure 1. Abdominal CT scan showing thickening and hematoma with only intramuscular contrast extravasation suggesting active bleeding confined inside the right diaphragmatic crus (arrows).

Discussion

In the acute phase, clinical manifestations related to BDI can range from asymptomatic or mild symptoms, as in our case, to hemodynamic instability **[7,9]**. Rib fractures, pneumothorax, pleural effusion, and hemothorax are the most frequent associations, present in 80-90 % of cases **[1]**. Amid the intraabdominal organ injuries, the liver (60-90 %) and spleen (50-60 %) are the most affected **[1,10]**. The *seat belt sign* in the physical examination is highly suggestive of intraabdominal injuries **[5]**. Mortality in the acute phase is usually between 20-30 % **[3,5,9]**, and brain injury, pelvic fracture, and hemorrhagic shock are the leading causes of death **[3,10]**. Other risk factors for higher mortality include age, high ISS (> 15), hollow viscus injury, and rib fractures **[3]**.

In the late or delayed phase, the mortality can increase up to 60-80 % **[4,8]** due to the development of diaphragmatic hernia and its complications, such as bowel herniation, incarceration, strangulation, perforation and mechanical or septic respiratory compromise **[7,9]**. If not present in the acute phase, the diaphragmatic hernia is diagnosed in 80 % of cases in the first 3 years of follow-up **[1]**. The stomach is the most frequently herniated organ overall, mainly if the hernia is located on the left hemidiaphragm, while the liver is the most commonly herniated organ on the right side, although rare **[1,3]**.

For the diagnosis, clinical suspicion is crucial. The initial X-ray exam has low sensitivity (27-63 %) unless a diaphragmatic hernia is already present **[3.11]**. Suspicious signs of diaphragmatic injury include elevation of the diaphragm > 4-6 cm, nasogastric tube in the thoracic cavity, pleural effusion, pneumothorax, and atelectasis, among others **[3,7,11]**. In hemodynamically stable patients, a CT scan is the preferred imaging study, with a sensitivity and specificity of 71-100 % and 75-100 %, respectively **[1,2,7,11]**. Some of the BDI signs include diaphragmatic thickening (caused by edema, hematoma -as we can see in our case- or muscle tear), peri-diaphragmatic contrast extravasation **[4,11]**, apparent visceral herniation or discontinuity of the diaphragm, constriction of the herniated organs at the level of the diaphragm (*collar sign*; also called *hump sign* in the right side, associated to liver herniation **[7]**) and abdominal organs in close contact to the posterior thoracic wall in a supine position (*dependent viscera sign*) **[4,8,12]**. In hemodynamically unstable patients, extended FAST (Focused Abdominal Sonography for Trauma) is used to identify hemoperitoneum as the cause of shock before urgent laparotomy and could help locate diaphragmatic injury **[7,9]**. However, the surgical approach and particularly urgent laparotomy remain the gold standard for diagnosing and treating diaphragmatic injury **[3,5,10]**, especially if we consider that in 10-60 % of cases, BDI can be missed without surgery **[1,8]**.

Advanced Trauma Life Support (ATLS ®) guidelines should be followed regarding the treatment. If the patient is hemodynamically unstable during the primary revision, the first step is to start resuscitation and stabilization measures prior to an extended FAST and urgent laparotomy **[7,9]**. If the patient remains unstable during surgery, a damage-control surgery should be performed, leaving the diaphragmatic repair to a second-look procedure in 24-48h **[7]**. Other urgent laparotomy indications include a positive FAST, evisceration, diffuse peritonitis, bowel perforation, pelvic fracture **[5]**, and extensive diaphragmatic injuries **[1,9]**. Urgent thoracotomy is indicated if a suspected injury of the heart or great vessels in a hemodynamically unstable patient **[3]**.

While exploratory laparoscopy is referred to in hemodynamically stable patients with penetrating trauma **[1,5,7]**, there is no clear consensus on managing blunt trauma. Non-operative management (NOM) can be performed if isolated diaphragmatic thickening and no other injuries are identified **[1]**. In the case of our patient, active intramuscular bleeding in the diaphragmatic crus with no

extravasation to the peritoneal cavity was present in the CT scan **(see Figure 1)**. There are no clear guidelines regarding this aspect in the literature. In one of the reported cases **[2]**, embolization was performed to successfully stop the hemorrhage with no further invasive measures, while in the second case, an exploratory laparotomy was performed **[11]**. However, we decided to perform NOM alone, which was also effective, being the first reported case to do so. If no other organ injuries are identified, this approach can be compared to that of the usually self-limiting hematoma within the *rectus abdominis* sheath: if the patient is hemodynamically stable and there are no signs of anemia, conservative treatment with analgesia, rest, suspension of anticoagulation, serial hemoglobin measurements, compression and, in some cases, active reversal of anticoagulation and blood transfusion can be performed, leaving embolization or surgical ligation to instances in which there is no proper response and the bleeding continues **[13]**. Similarly, the bleeding within the diaphragmatic crus can also be considered self-limiting via compression of the vessels by the hematoma itself in a limited space.

In any case, after a successful NOM, radiologic follow-up is mandatory with a CT scan at least 6 and 12 months after trauma **[7]** since the risk of delayed diaphragmatic hernia is high (40-60 %) after BDI **[1]**. If there is no response to NOM or in case of *an unclear abdomen* (defined as a normal CT scan and persistent abdominal pain), an exploratory laparoscopy is recommended **[5]**. Other surgical approaches in hemodynamically stable patients include thoracotomy or thoracoscopy if a suspected injury of the right hemidiaphragm, heart, or great vessels, as well as in case of apparent diaphragmatic hernia with no suspected abdominal injuries **[1,7,8]**.

Whenever it is performed, surgical treatment includes the primary repair of the diaphragm with a non-absorbable suture, with previous hernia reduction if present and posterior assessment of the repair's integrity with saline lavage **[3,7,9]**. Myocutaneous flap and prosthetic mesh can cover significant defects if the operating field is not contaminated **[7]**.

Conclusion

Crural diaphragmatic hematoma with active bleeding is a rare form of presentation of blunt trauma, with only two cases reported in the literature. In both cases, invasive measures were applied: embolization in one report and exploratory laparotomy in the second. However, after excluding the presence of contrast extravasation to the abdominal cavity and other organ injuries with a CT scan, successful non-operative management of active intramuscular bleeding in the diaphragm can be held, as in our case. This approach reduces the risks and morbidity associated with an urgent laparotomy or endovascular embolization in high-risk patients, such as those with chronic oral anticoagulation (especially those with no antidote), which conforms to a growing group of patients in the West. Radiologic follow-up must be performed in the following years to identify a possible delayed diaphragmatic hernia.

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