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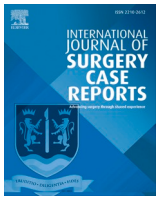

Case report

Laparoscopic repair of acute traumatic diaphragmatic hernia with mesh reinforcement: A case report

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ABSTRACT

Introduction and importance: Traumatic diaphragmatic injuries are rare and usually occur after thoracoabdominal trauma. Most patients will have other potentially life-threatening injuries. High index of suspicion is the most important attribute. Unfortunately, it is incorrectly diagnosed in up to 33% of cases. If left untreated, the onset of complications carries mortality rates between 25 and 80%.

Case presentation: We report a case of an acute diaphragmatic laceration in a 29-year-old male with thoracoabdominal trauma due to a road traffic accident. Physical examination revealed an absence of normal breath sounds in the left hemithorax. CT-scan confirmed a voluminous left diaphragmatic hernia with omental, gastric, and transverse colon content, so surgical intervention was advised. During laparoscopy, a 15 cm long and 5 cm wide diaphragmatic defect was identified. The hernia was reduced laparoscopically, and the defect repaired with interrupted non-absorbable sutures. As a reinforcement, a visceral contact prosthesis was placed. The patient had an uneventful recovery and after 12-month follow-up he has no evidence of recurrence.

Clinical discussion: Diaphragmatic injuries do not close spontaneously. An abdominal approach is recommended as it allows for evaluation of the entire abdomen and treatment of any associated injury. Watertight closure with nonabsorbable suture and in case of large defects, the placement of a mesh on the peritoneal side of the diaphragm is recommended to reinforce the primary repair.

Conclusion: Laparoscopic emergency surgery has proved to be effective and safe in selected patients with hemodynamic stability. Patients can expect the benefits of minimal invasive surgery with recurrence rate like the open approach.

1. Introduction

Diaphragmatic hernia is a protrusion of the abdominal organs or tissues into the thoracic cavity through a defect and can be classified as acquired or congenital. Traumatic diaphragmatic injuries are rare and usually occur after thoracic or abdominal blunt (3–5%) or penetrating (3–15%) trauma [1–3]. Possible mechanisms include lateral impact resulting in distortion and shear-stress on the chest wall and diaphragmatic attachments versus direct frontal impact causing sudden increase in intraabdominal pressure. Due to the indirect mechanism of injury with blunt trauma, most patients will have other significant and potentially distracting or life-threatening injuries, such as hepatic, splenic, or pancreatic injuries and renal lacerations, pelvic fractures, and aortic injuries [4]. Ruptures tend to occur at the central tendon or at the boundary between the tendinous and muscular part of the diaphragm. In blunt trauma, the left side is affected 65–85% of the time and the right side 15–35% of the time [5]. When diaphragmatic injuries associated with blunt abdominal trauma are discovered preoperatively, defect size is typically greater than 10 cm [4]. The standard treatment for diaphragmatic injury is surgical repair, and this should be performed as soon as a diagnosis is confirmed [6]. This work has been reported in line with the SCARE criteria [7].

2. Case presentation

A 29-year-old male patient without comorbidities was admitted to the emergency department after suffering thoracoabdominal trauma due to a road traffic accident (car versus lamppost). Regarding the

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mechanism of trauma, the patient was driving his car without the seat belt fastening at a speed of approximately 70 km/h, he lost control of the car in a curve and struck a lamppost on the driver's side. Fortunately, he was not fired from the interior of the car. The patient complained of left hemithorax and epigastric pain. On initial evaluation, he was hemodynamically stable with a Glasgow coma scale of 15/15 and normal vital signs. Physical examination revealed an absence of normal breath sounds in the left hemithorax. On admission, lab results were within normal parameters. A thoraco-abdominal CT-scan with intravenous contrast was performed, in which a voluminous left diaphragmatic hernia with omental, gastric, and transverse colon content was observed, and subsequent lung atelectasis of the lower lobe with moderate pleural effusion (Fig. 1). No other thoracic or abdominal injuries were reported. Upper gastrointestinal series showed the stomach inside the thoracic cavity full of iodinated contrast, with a correct passage to the duodenum. We decided to perform a laparoscopic approach in a semi-urgent scenario (within 24-48hs from the diagnosis). The patient was placed supine with arms extended in reverse Trendelenburg (head-up) position. Selective ventilation was used to limit the movement of the affected diaphragm. The pneumoperitoneum was established with a Veress needle inserted just above the umbilicus. A 10 mm camera optical port was placed at the umbilicus with visual assistance. The 4 remaining 5 mm ports for the surgeon (oesophagogastric surgery specialist) and the first assistant were placed under direct vision as shown in the picture (Fig. 2). An exploratory laparoscopy was performed, identifying the entire greater omentum, stomach, and transverse colon protruding through a 15 cm long and 5 cm wide diaphragmatic defect (diaphragmatic injury grade IV from the AAST Classification) (Fig. 3). No associated injuries were found. With the help of 2 graspers, we reduced the hernia content with thick tissue intakes and sustained traction. The triangular ligament of the liver was divided for a better visualization of the entire hernia defect. For closure, we made a tension-free repair with interrupted figure-of-8 sutures with polyester 2/0. As a reinforcement, a visceral contact prosthesis consisting of oxidized cellulose on the peritoneal side and polypropylene-polydioxanone was placed in contact with the diaphragm. For fixation, absorbable straps were placed in the form of a radiated crown (Fig. 4). The patient had uneventful postoperative outcomes consequence of early respiratory kinesiotherapy and self-mobilization. He was discharged after 72 h. A tomographic imaging control was performed 12 months after primary repair, in which there was no evidence of hernia recurrence (Fig. 5). Also, a spirometry was made in which no functional abnormalities of the respiratory system were found.

3. Discussion

In general, there is no hemodynamic compromise directly attributable to the diaphragmatic defect and the common symptoms in these patients include dyspnea, orthopnea and chest or scapular pain [8]. The diagnosis of a traumatic diaphragmatic hernia (TDH) can be challenging as the physical examination may be unremarkable, but a high index of suspicion is the most important attribute that allows for an early diagnosis especially in the presence of other severe injuries or when herniation is not present, in the context of rapid deceleration or crush injuries [9]. Most trauma victims receive portable chest radiograph in which direct or indirect signs of diaphragmatic rupture can be found. Unfortunately, the diagnosis may be missed by coexistent intrathoracic pathology such as atelectasis, hemothorax, pulmonary contusion or lacerations, loculated pneumothorax and so on. In this case, computed tomography (CT) with orthogonal reconstructions clarifies the diagnosis. Direct signs include diaphragmatic discontinuity and intrathoracic herniation of abdominal content [4]. TDH is incorrectly diagnosed in up to 33% of cases during the immediate post-traumatic period. If left untreated, the onset of complications carries mortality rates between 25 and 80% in patients with strangulation of incarcerated viscera [10,11]. Diaphragmatic injuries do not close spontaneously, however in some cases omental interposition may seal a tear temporarily. Therefore, the identification of even tiny diaphragmatic ruptures needs to be repaired and emergency surgery is the treatment of choice [4,5,9]. The management of TDH can be accomplished by laparotomy, laparoscopy or thoracoscopy, depending on the experience and skills of the surgeon involved as well also the availability of hospital facilities. Given the high rates of associated injuries to intraabdominal organs, an abdominal approach is generally recommended as it allows for evaluation of the entire abdomen with both hemidiaphragms and concomitant treatment of any associated injury [12]. Laparoscopic repair was first reported by Campos and Sipes in 1991 [13]. Since then, many reports have confirmed the safety and efficacy of laparoscopy for both diagnosis and repair, which is why the technique has been growing steadily worldwide. Good candidates are those hemodynamically stable, without obvious evidence of serious intraabdominal injury and minimal prior abdominal surgery. There is not a single technique of closure, however

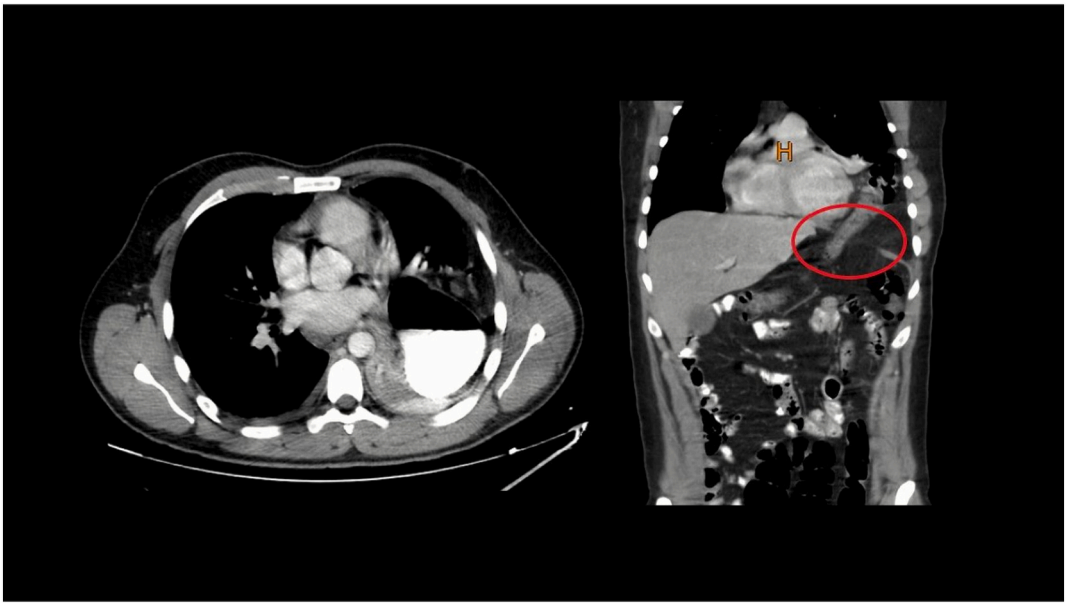

Fig. 1. CT-scan showing herniation of the stomach in the left hemithorax.

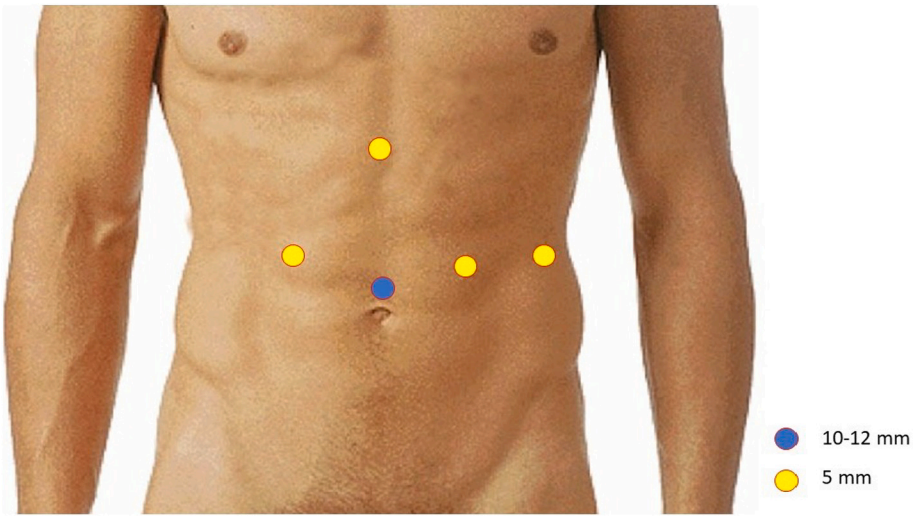

Fig. 2. Port placement.

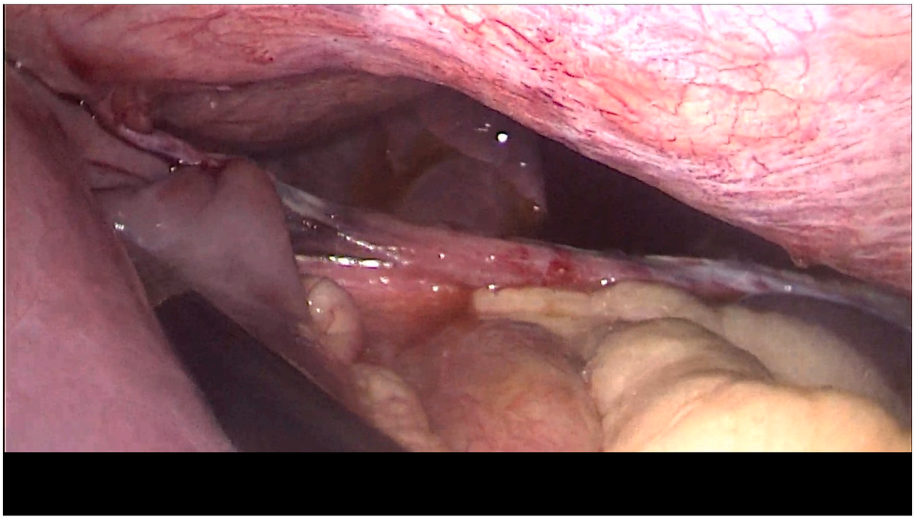

Fig. 3. Laparoscopic image showing the diaphragmatic defect.

all of them share the principles for repair that include complete reduction of the viscera, watertight closure with nonabsorbable suture and minimizing any additional injury to phrenic innervation of the diaphragm [12]. Laparoscopically, the hernial content can be safely reduced under direct vision in a controlled manner aided by lowering the intraabdominal pressure [14]. Although the type of closure is always a matter of debate, it is generally accepted that most defects can be primarily repaired with a nonabsorbable suture [9]. According to AAST (American Association for the Surgery of Trauma) Classification, diaphragmatic injuries are clustered into five grades: I (contusion), II (laceration $\leq$2 cm), III (laceration 2-10 cm), IV (laceration >10 cm with tissue loss $\leq$25cm^2), V (laceration with tissue loss >25cm^2) [15]. Those defects larger than 20–30 cm^2 (grades IV and V of the AAST Classification) usually need a prosthesis reinforcement [16]. Suturing large defects has the benefit of providing a flat surface for placement of the mesh, preventing mesh extrusion through the defect. Also, the placement of the mesh on the peritoneal side of the diaphragm is more physiologic because the intraabdominal pressure keeps the mesh opposed to the defect fulfilling the reinforcement function [14]. Translocating the results published in case series of Morgagni laparoscopic repair hernias in the adult, primary closure with mesh reinforcement reduces recurrence rates [17]. Regarding the type of mesh, the synthetic composite ones are the most frequently used but biologic mesh has recently been introduced to replace the previous ones because of its reduced adhesion formation, improved biocompatibility, decreased inflammatory response, optimal neovascularization, lower rates of hernia recurrence, higher resistance to infections and lower risk of displacement [18]. Nevertheless, considering the low incidence of TDH, the effectiveness of biologic implants in such situations are extrapolated from evidence derived from hiatal hernia repair and more scientific research articles.

4. Conclusions

Traumatic diaphragmatic injury is an uncommon entity but carries significant morbidity and mortality when associated injuries are not promptly diagnosed. The diagnosis can be challenging especially in oligosymptomatic patients, though the key being a high suspicious index. All diaphragmatic ruptures need to be repaired and laparoscopic emergency surgery has proved to be effective and safe for both diagnosis and repair in selected patients with hemodynamic stability. With large defects, this approach allows the placement of a synthetic composite mesh on the peritoneal side of the diaphragm to reinforce the primary repair. Patients can expect the well-known benefits of minimal invasive

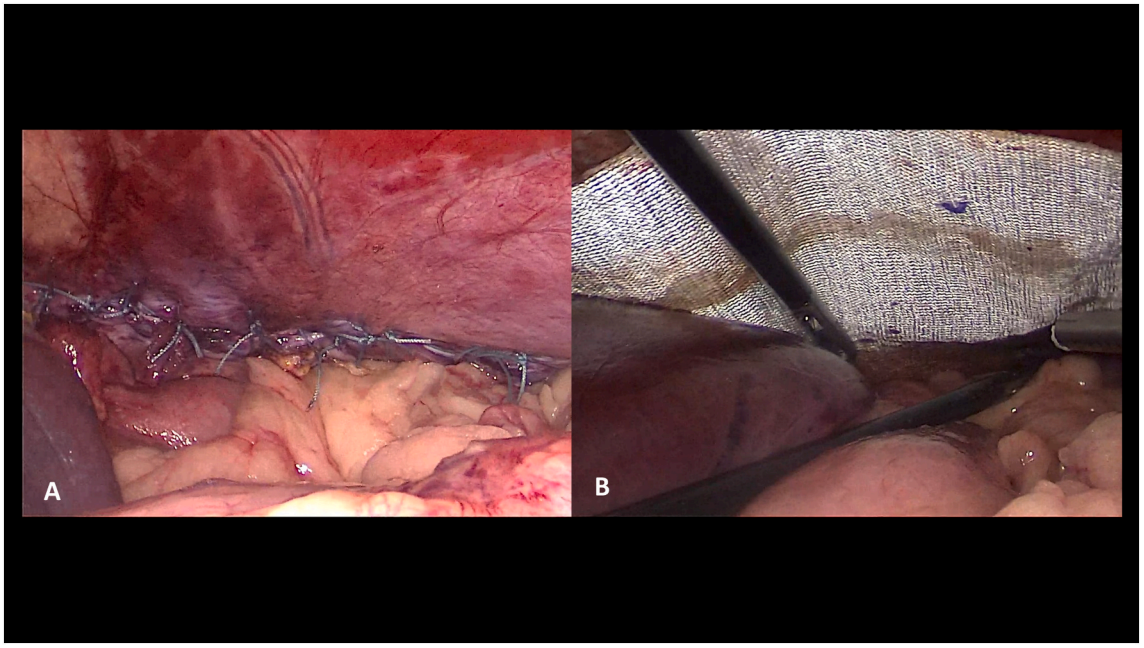

Fig. 4. Laparoscopic image showing: A- closure of diaphragmatic defect with interrupted non-absorbable sutures, B- reinforcement with visceral contact mesh.

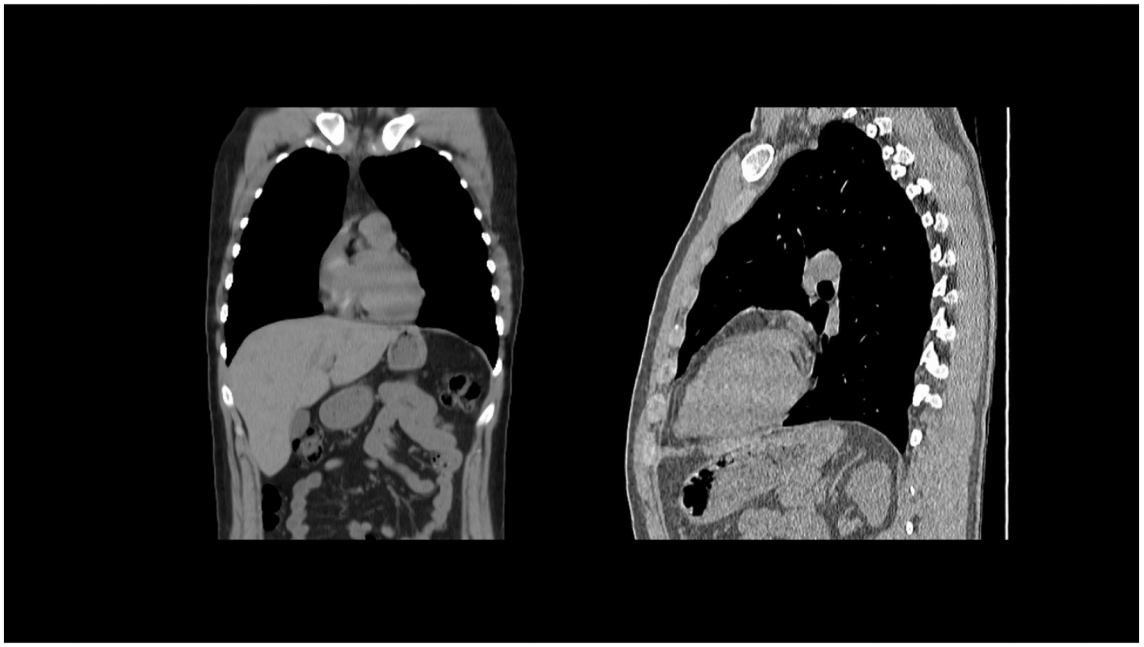

Fig. 5. CT-scan control 12 months after primary repair with no evidence of hernia recurrence.

surgery, such as an excellent view of the surgical field, earlier return to normalcy of pulmonary function, shorter hospital stay, lower post-operative pain and aesthetic benefits, with a recurrence rate like that for the open approach.

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Ethical approval

This is a case report study and ethical approval not required.

Informed 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.

Research registration

None declared.

Guarantor

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CRediT authorship contribution statement

Dr. Manuel Gielis: study concept and design, data collection, data analysis and interpretation, writing the paper, artwork editing.

Dr. Nicolas Bruera: data collection, data analysis and interpretation.

Dr. Agustín Pinsak: data collection, data analysis and interpretation, grammar correction.

Dr. Juan Antonio Muñoz: data collection, data analysis and interpretation.

Dr. Ignacio Olmedo: data collection, data analysis and interpretation.

Dr. German Viscido: study concept and design, writing the paper, grammar correction, bibliographic research.

Declaration of competing interest

The authors report no declaration of interest.

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