Resuscitative thoracotomy for non-traumatic tension viscerothorax

Diaphragmatic hernias are defined as partial or complete migration of one or more abdominal organs into the chest through a diaphragmatic defect. They are classified as congenital or acquired. Congenital hernias are more frequently diagnosed during infancy, whereas acquired hernias usually develop after thoraco-abdominal trauma and may have early or delayed presetation.[1,2]

Diaphragmatic hernias may become clinically evident either with respiratory distress or gastrointestinal complications.[3]

Here, we report the case of a 55-year-old woman presented to the emergency department complaining a 4-day history of epigastric pain associated with nausea and vomiting that had worsened over the last 3 h.

Her past medical history was remarkable for a depressive syndrome, hypertension, asthma and dyslipidaemia. Past surgical history included a laparoscopic gastric banding about 16 years earlier, complicated 12 years later by intragastric band migration requiring its endoscopic removal.

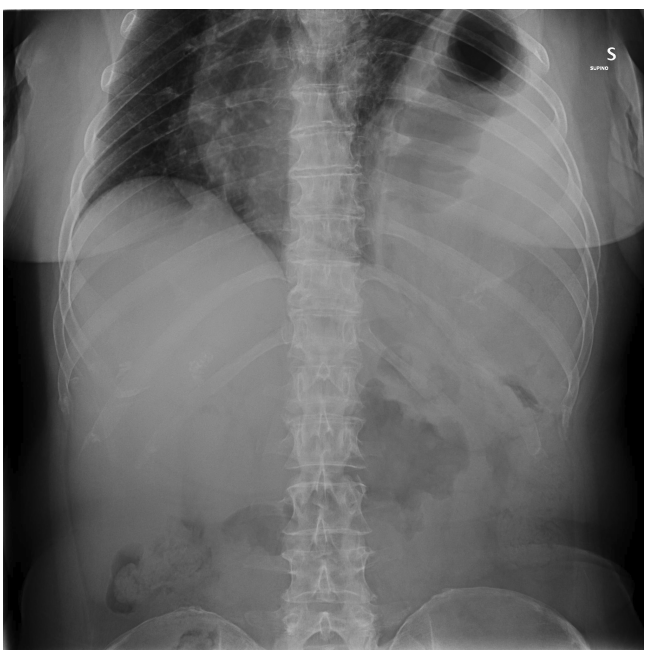

Fig 1. The abdominal X-ray showed a large diaphragmatic hernia with bowel migration into the chest. Notice the contralateral shift of the mediastinal structures, in particular the heart and tracheal carina.

At the time of examination, the patient was afebrile and slightly dyspnoeic, but haemodynamically normal. The electrocardiography (EKG) showed no alterations, and laboratory tests reported mild leukocytosis (white blood cells 12 470/mm^3) with normal C-reactive protein (1.1 mg/L). Troponin and haemoglobin were both within laboratory normal range. Radiographs and subsequent contrast-enhanced thoraco-abdominal computed tomography scan showed a diaphragmatic hernia with migration into the left hemithorax of greater part of the small bowel and colonic splenic flexure, determining a displacement of mediastinal structures to the right and partial kinking of the inferior vena cava (Figs 1,2).

Based on the radiological findings, a surgical indication was promptly given, and the patient was immediately prepared for surgery. On arrival at the preoperative holding area, a cardiac arrest occurred with EKG monitor showing pulseless electric activity. Therefore, cardiopulmonary resuscitation was immediately started, and the patient was intubated. After approximately 3 min of cardiopulmonary resuscitation, EKG showed persistent non-shockable rhythm.

Supposing a tension mechanism of the diaphragmatic hernia on the mediastinal structures, a resuscitative antero-lateral left thoracotomy was promptly performed in order to decompress the chest (Fig. 3). Once the manoeuvre was carried out, a shockable rhythm was detected on the monitor and return to spontaneous circulation was achieved after two defibrillation attempts. The patient was then immediately transferred to the operating room where a damage control strategy was preferred to definitive surgery operation due to the impaired physiology of the patient.

In detail, a median laparotomy was performed, and the diaphragmatic hernia was reduced, with partial direct repair of the diaphragm and clip-and-drop of the non-viable colonic splenic flexure. The abdomen was left open by the aid of a temporary abdominal closure system, whereas the chest was closed with an intercostal drain (ICD) in place. Afterwards, the patient was transferred to the intensive care unit on low-dose vasopressors, which were rapidly weaned as physiology was restored. Two days after, the patient underwent a relook laparotomy. During surgery, the large bowel stumps appeared perfectly viable, so that the previously resected colon was anastomosed. In addition, the diaphragm repair was reinforced by means of a dual mesh prosthesis, and the abdomen was definitively closed.

The postoperative course was uneventful. The ICD was removed after 4 days and the patient was discharged home on the 14th postoperative day.

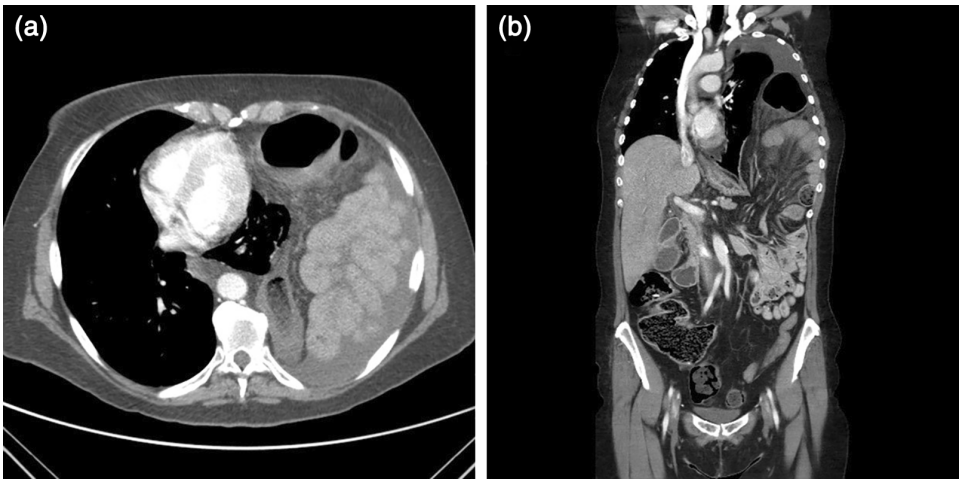

Fig 2. The contrast-enhanced thoraco-abdominal computed tomography scan showed a left diaphragmatic hernia with migration of greater part of the small bowel, colonic splenic flexure and stomach (a,b). Inside the hernia sac, there was free fluid without free air (a).

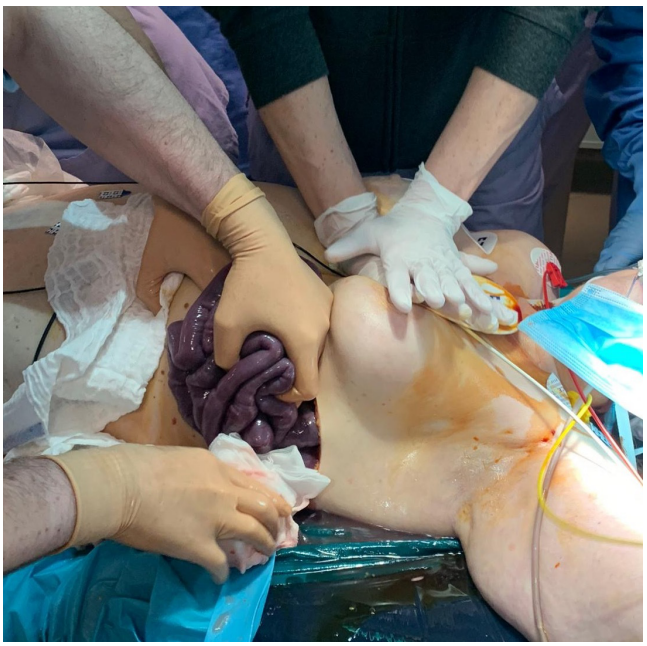

Fig 3. A left antero-lateral resuscitative thoracotomy during cardiopulmonary resuscitation allowed the evisceration of the small bowel, which reduced the ipsilateral intra-thoracic pressure, leading to a return of spontaneous circulation.

The 3-month follow-up chest X-ray showed no recurrency of the diaphragmatic hernia, and at 6-month follow-up visit the patient was in good general conditions, without incisional hernias or neurological impairment secondary to the cardiac arrest.

Tension pneumothorax is a life-threatening condition, where the ongoing entering of air into the pleural space causes a contralateral shift of the mediastinal organs, involving great vessels kinking and heart chambers compression. This progressively leads to hypotension, tachycardia, and, eventually, cardiac arrest.[4] The basic treatment for this condition is finger thoracostomy, which allows the compressed air to exit the pleural space, thus relieving the compression of mediastinal organs.[5] From the physio-pathological point of view, it does not matter whether the causing agent is pneumothorax, haemothorax, or any other condition. In fact, the mechanism involves a unilateral source of pressure on the mediastinum, which shifts it contralaterally, where the thoracic pressure is lower. When our patient arrested, we thought a similar mechanism had happened. In support to our hypothesis, the computed tomography scan images showed an initial kinking of the mediastinal vascular structures.

Although, to our knowledge, there are no significant reports in literature describing resuscitative thoracotomy to treat cardiac arrest due to the tension mechanism of a non-traumatic large diaphragmatic hernia,[6,7] in our setting it appeared to be the only treatment available to quickly decompress the chest, eviscerating part of the herniated bowel from the thoracic incision.[6]

In conclusion, resuscitative thoracotomy may be the only treatment option in a patient with a non-shockable cardiac arrest due to tension mechanism secondary to a large diaphragmatic hernia.

All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent by the institutional research committee is not required in Italy. Informed consent was obtained from the patient.

Author contributions

Alan Biloslavo: Conceptualization; data curation; project administration; supervision; writing-original draft; writing-review & editing. **Gabriele Bellio:** Conceptualization; data curation; supervision; writing-original draft; writing-review & editing. **Carlotta Giunta:** Investigation; visualization; writing-original draft. **Marina Troian:** Investigation; methodology; supervision; validation; writing-review & editing. **Nicolò de Manzini:** Project administration; supervision; validation; visualization.

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Alan Biloslavo, FACS, MD
Gabriele Bellio, MD
Carlotta Giunta, MD
Marina Troian, MD
Nicolò de Manzini, MD, FRCS
Department of General Surgery, Hospital of Cattinara, Trieste, Italy

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Laparoscopic enhanced view total extraperitoneal repair for rare and elusive arcuate hernia

We present a case of an arcuate hernia with a novel approach to repair involving laparoscopic enhanced view total extraperitoneal (eTEP) surgery.

A 46-year-old man presented with a several-month history of intermittent left-sided abdominal pain. He described a 'bulging' sensation on the left side of his abdomen at the site of pain, although there was no palpable mass on physical examination. He had a normal body mass index and no significant comorbidities, and a past history of bilateral laparoscopic inguinal hernia repair with mesh.

A computed tomography (CT) scan showed a small fat-containing paraumbilical hernia, although there was no significant finding on the left side of the abdomen. Due to ongoing clinical suspicion of a left-sided hernia, a targeted CT of the abdomen with Valsalva manoeuvre was undertaken. This confirmed an arcuate hernia on the left containing a loop of non-obstructed small bowel (Fig. 1).

This case was discussed at our hospital's hernia multi-disciplinary meeting attended by local and interstate surgeons with a specialty interest in hernia management. The consensus management plan was for laparoscopic eTEP hernia repair with mesh.

At operation, a right-sided, three-port laparoscopic retrorectus approach was undertaken. The retrorectus plane was developed from pubic symphysis to xiphisternum. During this process, reduction of small fat-containing paraumbilical and epigastric hernias was performed. A small hole in the peritoneum allowed an intraperitoneal view of the arcuate hernia (Fig. 2). This small defect in the peritoneum was closed with 3/0 polydioxanone suture (PDS). The retrorectus space was measured and a 30 × 30 cm Bard soft mesh (BD, Franklin Lakes, New Jersey, USA) was cut to size and placed in the retrorectus space (Fig. 3). The mesh was secured in place with Tisseal fibrin glue (Baxter, Deerfield, Illinois, USA). A 19-F Blake drain (Ethicon, Cincinnati, Ohio, USA) was placed in the retrorectus space and the pneumo-preperitoneum deflated under vision.

The patient made excellent post-operative recovery, with drain removal and discharge on day 2. At 6-week follow-up, he remained symptom-free with high self-reported patient satisfaction.

Arcuate hernia is a rare parietal interstitial hernia consisting of ascending protrusion of intraperitoneal contents above the arcuate line. The literature consists predominantly of case reports. Its prevalence in the general population is not established, although there

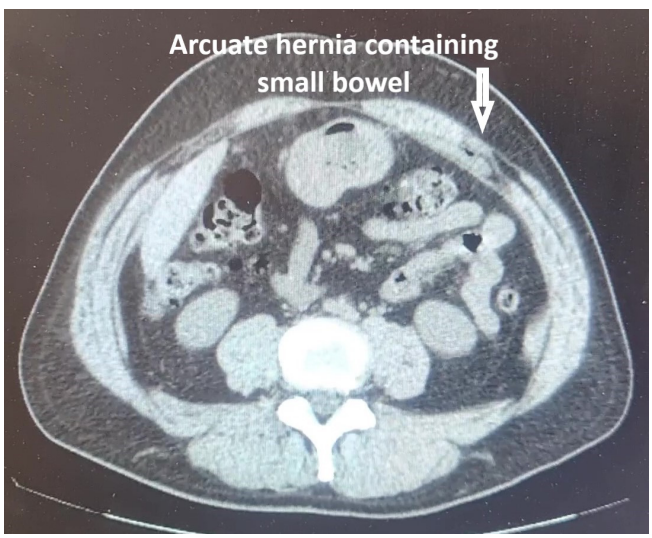

Fig 1. Axial computed tomography image with Valsalva manoeuvre showing subrectus mass with air indicating small intestine.