Thoracoabdominal approach for traumatic diaphragmatic hernia in a hemodynamically unstable patient

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Summary

Background Diaphragmatic hernias with strangulated contents are a surgical challenge. Thoracoabdominal incisions are commonly used for a variety of thoracic and vascular cases, although rarely used for diaphragmatic hernias, which are typically repaired with laparotomy, thoracotomy, or minimally invasive approaches.

Case report We present the unique case of a 60-year-old, critically ill unstable patient with severe heart failure with a reduced ejection fraction (15–25%) and severe valve disease presenting with a left-sided diaphragmatic hernia containing strangulated small intestine and requiring urgent surgical exploration. This was safely and efficiently repaired via a thoracoabdominal approach at the index surgery, with intestines left in discontinuity and placement of temporary chest and abdominal closure. At the second planned operation, good continuity was successfully restored.

Results The patient had early extubation, gradual diet advancement with full recovery, and discharge home on postoperative day 17.

Conclusion A thoracoabdominal incision can safely be used in large strangulated diaphragmatic hernias, including in critically unstable patients. This approach provides rapid access to both the chest and abdomen with excellent, speedy, and safe exposure, which can save a life in extreme conditions.

Keywords Thoracoabdominal incision · Strangulated hernia · Traumatic hernia · Complex chest trauma · Paraesophageal hernia

Main novel aspects

In critically unstable patients, surgeons may consider using thoracoabdominal incisions safely for optimal exposure. If necessary, temporary abdominal and chest closure may be used to aid resuscitation prior to return to second look operation.

Introduction

We present the unique case of a 60-year-old critically ill patient with heart failure presenting with a left-sided diaphragmatic hernia containing strangulated small intestine and requiring urgent surgical exploration. We report the safe and efficient use of a thoracoabdominal incision for optimal chest and abdomen exposure in an unstable patient. Informed consent was obtained from the patient.

Case

A 60-year-old male presented to the emergency room with one day of upper abdominal and chest pain, nausea, and vomiting. He had multiple medical co-morbidities including nonischemic cardiomyopathy with a reduced ejection fraction (15–25%), severe mitral and tricuspid regurgitation, and a recent prolonged hospitalization for COVID-19 pneumonia. Initial workup revealed leukocytosis (White blood cell count 14 k/uL) and a large left-sided diaphragmatic hernia containing a segment of small bowel without concern for compromise (Fig. 1). The chronicity of this hernia was unclear, although the patient had a history of a car accident several years ago. The
case report

The patient was admitted for nasogastric decompression and bowel rest.

That same evening, the patient deteriorated rapidly, with increased abdominal pain and worsening left pleural effusion requiring transfer to the surgical intensive care unit for resuscitation. Repeat imaging was concerning for bowel compromise and marked left-to-right mediastinal shift with large left pleural effusion (Fig. 2); hence, surgical intervention was deemed necessary that evening (12/5/2021). Due to his extensive cardiac comorbidities, cardiac anesthesia and cardiac surgery teams were pre-emptively involved in the event that extracorporeal membrane oxygenation (ECMO) or intra-aortic balloon bump (IABP) cannulation were needed. Prior to induction of general anesthesia, right common femoral vein (CFV), left common femoral artery (CFA), and pulmonary artery Swan Ganz catheters were placed for cardiac monitoring and access for swift conversion to VA ECMO, if needed. Upon induction of anesthesia, the patient experienced a cardiac arrest requiring chest compressions and insertion of a left chest tube with evacuation of 2 litres of pleural effusion. The patient achieved return of spontaneous circulation; hence, VA ECMO was not needed and the decision was made to proceed with surgery given that patient was now clinically stable and on minimal vasopressor support.

The patient was positioned in the right lateral decubitus position, with the right arm extended and the bed flexed for optimal chest and abdominal exposure for the subsequent thoracoabdominal incision. This was done by performing a left thoracotomy in the seventh intercostal space and dividing the costal arch. Inspection revealed gangrenous small intestine in the upper chest with signs of impending perforation (Fig. 3). The thoracotomy was then extended to an upper midline laparotomy by dividing the diaphragm toward the defect in the posterolateral diaphragm, thus connecting these two planes and allowing full access to both cavities.

It was possible to reduce the small bowel into the abdomen. A 75 cm segment of gangrenous jejunum with irreversible ischemia was resected using surgical staplers. The decision was made to leave the patient in continuity without creation of an anastomosis or ostomy given the recent cardiac arrest, the state of multfactorial shock, and to allow for a second-look procedure. As such, the two stapled blind ends of the intestine were left in situ in the abdomen. The abdomen itself was left open via placement of a temporary negative pressure wound vacuum system, while the chest was temporarily closed by placing several paracostal sutures for rib approximation, followed by closure of the skin with running suture. The patient was then transferred to the intensive care unit for further resuscitation, where he remained stable on minimal vasopressor support. Two days later, on 12/7/2021, a second-look surgery was performed in the operating room again in conjunction with general surgery and thoracic surgery.

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Fig. 1  Computed tomography showing the left diaphragmatic defect containing a segment of small intestine (yellow arrows)

Fig. 2  Computed tomography of the chest. a Coronal section showing the left lung field completely replaced by incarcerated small intestine diaphragmatic hernia extending to the apex of the left pleural space (yellow arrows), and b an axial section demonstrating the same diaphragmatic hernia
The patient was again placed in the right lateral decubitus position. The existing negative pressure wound vacuum system was taken down, followed by an abdominal exploration. The remaining small bowel appeared viable and healthy; hence, gut continuity was restored via creation of a stapled side-to-side anastomosis. The left hemidiaphragm was repaired by the thoracic team with biologic mesh, given the prior contaminated chest field containing gangrenous intestine. This mesh was sewed to the lower aspect of the diaphragmatic defect using interrupted horizontal mattress sutures as an underlay. The superior aspect of this mesh was then cut to prevent diaphragmatic elevation due to laxity, while at the same time ensuring no undue tension on the mesh. The costal arches were then reaproximated with suture, followed by closure of the chest wall in multiple layers. The patient was then transported back to the ICU for further care.

In the ICU, the patient continued recovery and was quickly weaned off vasopressor support, followed by early extubation. Diet was gradually advanced and after a full recovery, the patient was discharged home on day 17.

At 9 months follow-up, the patient was doing well from a surgical standpoint, without any issues reported with thoracic or abdominal incisions, diet, ambulation or activity. He continues to be in cardiologic follow-up for ongoing medical management of his severe heart failure and valvular disease.

**Discussion**

Left-sided traumatic diaphragmatic hernias are more common than right-sided, due to the relative protection of the liver on the right side [1], consistent with our patients’ presentation. This diagnosis remains a challenge for clinicians, and several strategies have been developed for surgical management of these hernias based on chronicity. For acute traumatic diaphragmatic hernias, the abdominal approach is more commonly employed to explore for other evidence of concomitant abdominal injuries, whereas for chronic hernias, the thoracic approach is more common as it is difficult to release dense intrathoracic adhesions via laparotomy [1]. Depending on the mechanism of injury, in acute settings, due to concomitant injuries, a combined approach may have to be used [2]; however, the use of a thoracoabdominal incision is rarely reported in the literature despite several studies showing that this incision has a similar morbidity profile compared to conventional incisions, including thoracotomy and laparotomy [2, 3]. Kishore et al. mentioned the use of this incision for traumatic diaphragmatic hernia in 1 out of 29 patients [4]. Other centers have reported the use of endoscopic or robotic repairs of such hernias; however, this is highly surgeon dependent and patient specific [1].

Our patient had profound hemodynamic instability and would hence not have been able to tolerate a minimally invasive approach involving insufflation such as laparoscopy or thoracoscopy. The giant nature of the hernia necessitated use of both an abdominal and a thoracic approach, and this is where the thoracoabdominal incision demonstrated superiority in terms of rapid access to both these body cavities. In our case particularly, this rapid access proved useful especially in a severely hemodynamically unstable patient, thus demonstrating its safety. We were also able to temporarily close both these cavities to allow for relatively easy access for a second-look surgery, something that we have not seen described in the existing literature.

**Conclusion**

A thoracoabdominal incision can safely be used in large strangulated diaphragmatic hernias, including...
in critically unstable patients. This approach provides rapid access to both the chest and the abdomen, with excellent speedy and safe exposure which can save a life in extreme conditions.

**Declarations**

**Conflict of interest** M. Mubashir, J.O. Barron, H. Mubashir, A. DeMare, S. Raja, S. Murthy, and D.P. Schrafnagel declare that they have no competing interests.

**Ethical standards** For this article no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case. For images or other information within the manuscript which identify patients, consent was obtained from them and/or their legal guardians.

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