

## Diaphragmatic Hernia Caused by Iatrogenic Injury; Two Cases and a Review of the Literature

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Received: February 12, 2020

Published: February 19, 2020

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### Abstract

Diaphragmatic hernia resulting from iatrogenic injury is quite rare, and poses risk of acute obstruction, strangulation or perforation of abdominal organs. Iatrogenic injuries can be small and go unrecognised at time of surgery. We present two such cases of patients with diaphragmatic hernia causing acute obstruction or strangulation requiring emergency surgery. Both patients had history of upper abdominal surgery, with presumed iatrogenic injury as the underlying cause for the diaphragmatic hernia.

We discuss here the potential risks and pitfalls of unrecognised iatrogenic diaphragm injury and review the relevant literature.

**Keywords:** Diaphragmatic Hernia; Iatrogenic Injury; Surgical Complication

### Abbreviations

CT: Computed Topography; ICC: Intercostal Catheter; DJ: Duodenojejunal.

### Introduction

The diaphragm provides a musculotendinous barrier between the negative pressure of the thorax and positive pressure of the abdomen. Diaphragmatic hernia occurs when there is a defect in the diaphragm, allowing herniation of abdominal contents through the diaphragm into the chest. This can pose risk of obstruction or strangulation of abdominal contents, and may lead to ischaemia and perforation.

The majority of diaphragmatic hernias are either congenital or due to trauma, and whilst iatrogenic injury is rare it is important to recognise the potential implications.

While some iatrogenic injuries may become immediately apparent, resulting in large obvious defects, others may be due to poor healing of a diaphragmatic repair, or minor diathermy burn and hence present some time later. A high index of suspicion is important in patients with a history of previous upper abdominal surgery.

We describe here two unusual cases of iatrogenic diaphragmatic injury resulting in later acute diaphragmatic herniation and strangulation requiring emergency surgery.

### Case Reports

#### Case 1

A 78-year-old male presented to the Emergency Department with three days of nausea, abdominal distension and obstipation.

His medical history included high cholesterol, hypertension, gout and diverticular disease. Of note, 5 months earlier, he presented with an acute gastric volvulus associated with a large hiatus hernia. He underwent laparoscopic hiatus hernia repair with bio-A mesh and 180 degree fundoplication. During surgery, a 2x1 cm hard nodule was excised from the left crura of the diaphragm using diathermy. This was not full thickness, did not result in a defect in the diaphragm at that time, and hence was not repaired. His recovery from that surgery was uncomplicated and he was well on 2-week review.

At current presentation, a plain chest radiograph revealed marked gaseous distension of a bowel loop projecting over the left mid and lower lung zone, concerning for diaphragmatic hernia (Figure 1). A Computed Topography (CT) scan with intravenous contrast showed a defect in the left hemidiaphragm measuring 46.5 x 25 mm. An obstructed loop of transverse colon was extending into the hernia defect, with upstream dilatation of right colon up to 9 cm (Figure 2). Laboratory tests were largely unremarkable apart from a mild leukocytosis of 10.2 mmol/L (4.0-10.0 mmol/L) and an elevated lactate of 2.3 mmol/L (0.5-2.0 mmol/L) on venous blood gas.

Emergency laparoscopy revealed a left hemidiaphragm defect lateral to previous hiatus hernia containing viable transverse colon and omentum. The 180 degree anterior wrap was intact. The hernia was reduced and the diaphragmatic defect repaired with sutures, reinforced with bio-A mesh secured with glue and tisseal. Left sided intercostal catheter (ICC) was inserted and secured to underwater drain.

Three serosal tears were noted on the transverse colon during dissection and the decision was made in consultation with the

**Figure 1:** Chest radiograph demonstrating loop of large bowel in left chest.

**Figure 2:** CT chest/abdomen/pelvis demonstrating a hernia defect in the left hemidiaphragm (arrow) containing obstructed colon.

colorectal surgeon on call to observe, with planned re-look laparoscopy in two days.

At planned diagnostic laparoscopy, the serosal tears had healed or were walled off by omentum. There was no evidence of perforation or peritoneal contamination. Colonoscopy revealed normal colonic mucosa.

The patient had some minor issues with fluid overload and delirium in the initial postoperative period which resolved in hospital. ICC was removed on the sixth postoperative day without complication and the patient was discharged to an inpatient rehabilitation facility eleven days post hernia repair. On one month review he reported some problems with weight loss and fatigue, which were slowly improving three months later. He remains well.

## Case 2

A 55-year-old lady presented to the Emergency Department with 14 hours of epigastric pain associated with vomiting. Her only past medical history was an elective open radical resection of a very large right sided adrenal myolipoma, with right hemihepatectomy, three years prior.

Laboratory investigations were concerning with a marked leukocytosis of 13.2 mmol/L (4.0-10.0 mmol/L), and an elevated lactate of 4 mmol/L (0.5-2.0 mmol/L) on venous blood gas. Other laboratory tests were within normal limits. CT scan demonstrated a central posterior diaphragmatic hernia on the right, containing small bowel (Figure 3). Dilated loops of jejunum were seen extending through the hernia defect, with appearances concerning for possible early ischaemia.

**Figure 3:** CT abdomen/pelvis demonstrating right sided diaphragmatic hernia (arrow) containing strangulated small bowel.

Emergency laparotomy revealed a defect in the right diaphragm measuring 10 cm with omentum and 30 cm of black, ischaemic small bowel herniating into the chest. The involved small bowel was approximately 70 cm from the duodenojejunal (DJ) flexure. A suture was noted in the diaphragm immediately adjacent to the hernia, indicating likely repair of diaphragm injury during original surgery.

The hernia was reduced, thoracic cavity irrigated with normal saline and an ICC was placed. A primary hernia repair was performed using interrupted figure-of-eight 1.0 nylon sutures. The ischaemic segment of bowel was resected and a side-to-side hand-sewn antiperistaltic anastomosis was formed.

The patient was discharged home on the tenth postoperative day, after her initial ileus had resolved. She was readmitted 6 weeks later with a delayed presentation of a wound collection, concerning for potential small bowel fistula on imaging. The wound was

explored and washed out in the operating theatre, and the fascia was intact without evidence of communication with bowel or any enteric content. The patient recovered well and was discharged from hospital with daily wound care two days later.

## Discussion

Acquired diaphragmatic hernias are most commonly due to blunt or penetrating chest trauma [1], more frequently on the left hand side. Iatrogenic injuries represent the second commonest cause of acquired diaphragmatic herniae [2].

Diaphragmatic injuries due to blunt trauma tend to be recognized at time of injury, as they are often large radial tears in the diaphragm due to increased abdominal pressure, which result in acute herniation of abdominal contents into the chest cavity [3].

Penetrating traumatic injury to the diaphragm tends to result in smaller defects which may be missed at initial presentation, behaving similarly to unrecognized intra-operative injuries. Use of laparoscopic graspers and electrocautery dissection in the area of the diaphragm can potentially lead to small, unrecognized injuries or weak points in the muscle [4]. Overall morbidity of diaphragmatic hernias can be as high as 68%, often due to the fact that traumatic injury often results in other associated injuries [5,6].

Both cases we have described demonstrate emergency presentations of strangulated diaphragmatic hernias, likely resulting from iatrogenic injury to the diaphragm during previous surgery. There were no interval symptoms between the first and second surgery, suggesting that the herniation was acute. This was further supported by the lack of chronic hernia sac or adhesions found at surgery in both cases.

There are a handful of other cases describing similar occurrences published in the literature today. Emergency presentations of diaphragmatic hernias have been reported following laparoscopic upper abdominal surgery; including biliary procedures such as cholecystectomy and hepatectomy [7-10], gastric procedures such as gastric banding, gastrectomy or fundoplication [4,11-13] and cases of splenectomy [14,15].

While patients may present with gastrointestinal symptoms due to an obstructing pathology, as was seen in our cases, there have also been reports of less acute gastrointestinal symptoms, associated with respiratory symptoms due to a larger but non-obstructed, or only partially obstructed hernia causing mass effect on the lungs [16-18]. In these cases, patients tended to experience symptoms for up to several months before they were diagnosed. Significantly, many subsequently required bowel resection for ischemia [16-18]; highlighting the seriousness of even a less acute presentation.

There have been a number of case reports of acquired diaphragmatic herniae in pediatric patients following liver transplant. This

has led some authors to theorize that, aside from intra-operative injury to the diaphragm, potential risk factors include malnutrition, immunosuppression, thin diaphragmatic musculature (related to low BMI and malnutrition) poor wound healing, ascites and raised intra-abdominal pressure [16,18].

In all the cases reported in the literature, the patients required emergency surgery to repair the diaphragmatic defect, often with resection of ischemic bowel. Most authors report primary suture repair. Mesh reinforcement has been described in some cases, but presumably is often contraindicated because of contamination and infection risk where bowel injury has been significant [18].

## Conclusion

While a rare complication of surgery, iatrogenic diaphragm injury can lead to risk of acute diaphragmatic herniation and strangulation, as well as respiratory compromise. The risk of injury may be reduced by ensuring precise dissection when operating in the area of the diaphragm, vigilance with regard to potential diathermy burn injury and incorporating a final visual inspection of the diaphragm at the end of upper abdominal surgical procedures. Any diaphragmatic injury should be treated seriously, and repaired with care. If an injury has occurred, or dissection around the diaphragm has been difficult, extra care should be taken to optimize nutrition and other risk factors where possible. In those who have had previous upper abdominal surgery, particularly around the diaphragm, an index of suspicion should be maintained, given the extended time frame and non-specific symptoms with which patients may present.

## Conflicts of Interests

The authors declare there are no conflicts of interest for this article.

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