CASE REPORT

A novel technique for repairing a large diaphragmatic defect with no costal attachments

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SUMMARY

Chronically ruptured diaphragms are difficult to diagnose. Often they are asymptomatic but convey a high risk for incarceration, and therefore surgical repair is mandatory. In the following case report, we present an abnormal 10×12 cm diaphragmatic defect whereby there was no anterior edge to the defect. This posed a challenge as to how to repair. We present a novel technique that facilitates sound solution through a thoracotomy approach.

BACKGROUND

The importance of this paper is centred on the novel approach of dealing with a large anterior diaphragmatic defect with no anterior costal attachments. Patch repair becomes difficult for two reasons; access to the anterior aspect of the hernia is limiting by the oblique course of the ribs. Furthermore, there is no rim of tissue for the patch to hold on to.

Under the circumstances we improvise a novel approach: using a second thoracotomy incision two intercostal spaces below the first incision we anchored pledgetted-interrupted sutures subcutaneously and we used them to secure the mesh patch anteriorly. Subsequently the second incision was closed in layers and therefore the pledgetted sutures were buried resulting in elimination of the risk of infection.

CASE PRESENTATION

A 49-year-old, previously fit and well gentleman presented 6 days after a sporting injury complaining of left upper quadrant pain and discomfort. He was haemodynamically stable, with guarding evident in the left upper quadrant.

INVESTIGATIONS

Blood lactate level was 4.0 mg/l. All other haematinics, electrolytes and inflammatory markers were within normal ranges. An ECG was normal sinus rhythm at 68 bpm. An erect chest x-ray revealed a large air-filled structure within the left hemithorax.

DIFFERENTIAL DIAGNOSIS

Initially, musculoskeletal and splenic injuries were considered, but the chest radiograph eluded to a diaphragmatic hernia on the left side (figure 1).

TREATMENT

A subsequent CT diagnosed a complex diaphragmatic rupture involving small and large bowel, stomach, tail of pancreas and spleen, with a small

volume of intrathoracic free fluid. Urgent surgical repair was undertaken via a standard posterolateral thoracotomy through the sixth intercostal space. Surprisingly, it was found to be a large 10 × 12 cm defect of the left hemidiaphragm anteriorly and lateral to the left internal mammary artery. The defect deemed to be old because of its large size, the thickened edges posteriorly and lateral and also the fact that a chronically organised hernia sac was identified (figure 2). The patient's further injury 6 days ago had produced an acute element with further herniation of intra-abdominal organs medial to the old sac.

The content was incarcerated, but not strangulated. Once the sac was mobilised and reduced, a large defect was evident involving the anterior aspect of the left hemidiaphragm, with no anterior edge to facilitate repair.

Mesh repair of the defect using interrupted 2/0 pledgetted-polypropylene sutures in order to anchor a prolene mesh to the diaphragmatic edges was used. However, there was no diaphragmatic ridge antero-costally in one-third of the perimeter of the defect. Therefore it became apparent that in order to secure the mesh anteriorly with pledgetted interrupted non-absorbable sutures we would have to improvise.

Figure 1 A coronal CT image. A left diaphragmatic hernia orifice can be seen, with the spleen seen superiorly to this. It had herniated through the defect along with the stomach and the tail of the pancreas.

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Figure 2 From top left clockwise: (A) Diaphragmatic defect with hernia sac protruding into the left hemithorax. Prolene sutures have been placed in order to perform a tension free mesh repair. (B) Hernial sac reduced and controlled by a surgical swab. The problematic absence of an anterior rim can be seen. (C) Second incision made at the 10th rib space inferior to the original thoracotomy incision. Pledged prolene sutures have been placed in order to secure the mesh repair anteriorly. (D) The secured tension free mesh repair.

We decide to place the sutures corresponding to the rimless defect on the chest wall 'level' with the defect. A second incision was made at the level of the 10th rib and only deepened to the level of the muscle; we were then able to accurately place horizontal mattress pledged sutures (using a large straight needle) and also buried them under the subcutaneous tissue so avoiding introducing infection. Therefore the second subcutaneous incision allowed anchoring pledged sutures to be passed from the chest wall inside the thoracic cavity and through the mesh providing a secure repair. Once all the sutures were in position, the prolene mesh was 'parachuted' and tied in place.

OUTCOME AND FOLLOW-UP

The patient remained ventilated in the intensive care unit for a further 36 h before being transferred to the high-dependency unit. He progressed well thereafter and was discharged home on day 6.

A repeat CT scan of his chest at 30 days excluded recurrence.

DISCUSSION

Traumatic diaphragmatic rupture is a rare but serious and typically occurs in high-speed accidents.¹

We believe that this was a chronic defect, because of an old unreported trauma with an acute exacerbation owing to recent abdominal trauma. It became an emergency owing to acute incarceration of the content.

The defect was lacking a rim of diaphragmatic tissue in its anterior-costal portion. Furthermore, the oblique position of the chest wall in this area would preclude any attempt to place accurate direct sutures through the periosteum of the parietal pleural side.

An alternative would have been to bring the prolene mesh through the thoracotomy incision, however this would have increased infection risk.

A recent meta-analysis² has shown that repair can be performed via several techniques. For chronic hernia repair thoracotomy is indicated, while acute and traumatic diaphragmatic herniation requires laparotomy owing to the risk of strangulation of the sac content.^{3 4}

Large defects such as in this case, require repair with the use of a mesh owing to the continuous mechanical and physiological demands put upon the repair.⁵ Several types of mesh are available, both artificial and bioprosthetic, but the choice of which to use is at the surgeons discretion. Polypropylene mesh, despite the associated risk of erosion and adhesion formation, is favoured because it yields excellent tissue ingrowth and provides a strong tissue line, reducing the risk of recurrence.^{5 6}

We advocate the use of a second lower incision deepened only to the chest wall with the intercostal muscles intact. This provides access to anatomical insertion of the diaphragmatic fibres and allows for an accurate dome-shaped diaphragmatic reconstruction. The first advantage to this approach is an increase in intrathoracic volume, thereby aiding lower lobe expansion. Second, the risk of infection is reduced as the second incision was for transthoracic stitch placement only, and there was no direct communication of the mesh with the superficial wound.

While the use of two thoracotomy incisions has been reported for extrapleural pneumonectomy,⁷ there are no literature reports as to how to repair rimless diaphragmatic defects; therefore we believe, we are the first to describe a novel technique for solving out a technically challenging problem.

Learning points

- ▶ Although rare, the astute clinician should be aware of a diaphragmatic hernia in the differential diagnosis. Surgeons often need to think laterally in order to address issues which may only become apparent at the time of surgery.
- ▶ A novel approach of using a separate, second incision at the level of the actual anatomic insertion of the diaphragm. The incision was only deepened up to the level of the chest wall and the intercostal muscles were left intact.
- ▶ We advocate the attachment of the patch as described in the manuscript (by replicating an anterior costophrenic recess) in order to be able to create a supportive mechanism for the 'tension-free' patch repair. Positioning the mesh in a complete anatomical position using the technique described preserved the diaphragmatic configuration.
- ▶ By increasing the vertical length of the hemidiaphragm we believe that we increased the intrathoracic volume which can only further facilitate lower lobe expansion.
- ▶ Keeping the mesh entirely within the thorax (the intercostal muscles of the second incision are not breached) eliminated any direct communication between the superficial wound and the mesh repair.

Competing interests None.

Patient consent Obtained.

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