CASE REPORT

CT pleurogram for diagnosing an occult diaphragmatic tear

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SUMMARY

A 27-year-old man road traffic accident victim, in his initial CT, showed fractures in left lower ribs, pleural effusion and splenic and pancreatic lacerations. The left pleural effusion, drained with an intercostal tube, did not show any significant reduction in size and pleural fluid amylase was abnormally high. A diaphragmatic tear was suspected. Contrast was injected through the intercostal tube and a CT was performed, which revealed a small diaphragmatic tear and communication of the pleural space with peritoneum and the pancreatic laceration site.

BACKGROUND

The typical features of diaphragmatic tears, such as abnormally high diaphragm, herniated viscera and disrupted diaphragm contour, are only seen in cases of large tears. Small tears are usually missed in X-ray and even in CT, as in our case, where initial X-ray and CT did not reveal any evidence of diaphragm tear; however, a CT pleurogram, carried out by infusing contrast via the intercostal tube, revealed a small tear in the left diaphragm and communication of the pleural space with peritoneum.

CASE PRESENTATION

A 27-year-old man suffered a road traffic accident while riding a motorbike, with impact on the left lateral aspect of the body. He presented to the casualty department with difficulty in breathing and left upper quadrant abdominal pain. On examination, he had abrasions and swelling involving the left side of the chest wall, decreased breath sounds in bilateral lung bases, bony crepitus on the left chest wall and severe tenderness in the left upper quadrant with abdominal guarding. Bowel sounds were heard to be normal. Routine blood investigations were normal.

INVESTIGATIONS

Initial chest anteroposterior X-ray showed fractures of the left fourth to ninth ribs. There was no free air under the diaphragm and both domes of the diaphragm were normal in position. An abdominal ultrasonogram revealed splenic laceration with a perisplenic collection, pancreatic laceration involving the body and minimal free fluid in the abdomen.

CT of the thorax and abdomen was performed. There was bilateral pleural effusion ([figure 1A](#)), on the left more than the right side, as well as passive collapse of the basal segments of lung bilaterally. There was a splenic laceration of 2 cm involving the upper pole ([figure 1C](#)), a parenchymal

haematoma involving the lower pole measuring 4×3 cm ([figure 1B](#)) and a perisplenic collection. There was a deep laceration noted in distal body of the pancreas. Minimal haemoperitoneum was noted ([figure 1D](#)). There was no herniation of bowel loops into the thoracic cavity.

An intercostal tube was inserted into the left pleural space and around 600 mL of fluid was drained in 2 days. The drained fluid was initially bloody, later turning serous in nature. Pleural fluid showed an abnormally increased amylase level (1015 IU/L) and there was no significant reduction in the size of the effusion on repeat radiographs. This raised the suspicion of a diaphragmatic tear leading to pleuroperitoneal communication.

We decided to perform a CT pleurogram to look for a diaphragmatic tear. About 100 mL of diluted non-ionic contrast was injected via the intercostal tube and CT was carried out. It revealed leak of contrast into the peritoneal cavity through a small tear in the posterolateral aspect of the left dome of the diaphragm ([figure 2B](#)). Contrast was seen lining both pleural and peritoneal surfaces of the left diaphragm. Within the peritoneal cavity, the contrast traced into the lesser and greater sacs ([figure 2C](#)) and insinuated into the dehiscence formed by the pancreatic laceration ([figure 2D](#))—suggesting a pancreatic pleural effusion. This explained the abnormally elevated amylase levels in the pleural fluid.

TREATMENT

The patient was advised a surgery for repair of the diaphragmatic tear and was also warned about the possible complications of an untreated tear. However, he refused surgery and opted for conservative management.

OUTCOME AND FOLLOW-UP

The patient was haemodynamically stable throughout the course of his stay. A chest X-ray taken 2 weeks after admission showed that the left pleural effusion was very much reduced and lung was normally aerated. Repeat CT showed minimal pleural fluid and reduction in the size of the perisplenic collection. The intercostal tube was removed. The patient did not have any breathing difficulty and his abdomen pain was reduced.

On a 3-month follow-up chest X-ray, both domes of diaphragm were in normal position and there was no evidence of pleural effusion or bowel herniation. The patient has been told about possible delayed complications and has been asked to report for a half-yearly follow-up.

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Figure 1 CT images in soft tissue window: (A, B and D) are axial images and (C) is a coronal reformatted image showing bilateral pleural effusion and basal atelectasis in (A) pancreatic body laceration (arrow in B), splenic parenchymal haematoma (asterisk in B), splenic laceration (arrow in C) and haemoperitoneum (asterisk in D).

DISCUSSION

A diaphragmatic tear can occur with both blunt and penetrating trauma. Left-sided tears are more common than right-sided tears.¹ This is possibly due to the cushioning effect of the liver in the right side. Diaphragmatic tears can occur with frontal as well as lateral impact. Frontal impact causes a sudden abnormal increase in intra-abdominal pressure leading to a tear oriented radially in the weakest point of the diaphragm—the posterolateral aspect.² Lateral impact causes compression of the chest wall towards the vertebrae and can shear the diaphragm.³ Penetrating injuries usually cause small focal tears. Isolated diaphragmatic tears are rare and patients usually have an associated haemothorax and pneumothorax (90%), pelvic fractures (25%), splenic and liver lacerations (25%) and aortic injury (5%).⁴ If bowel herniation has occurred, physical examination may reveal the presence of bowel sounds in the chest on auscultation.

Imaging findings

Initial chest X-ray may show findings in only 25–50% of diaphragmatic tears.⁴ Findings suggestive of diaphragmatic tear are: (1) apparent elevation of hemidiaphragm; (2) loss of contour of the hemidiaphragm; (3) bowel herniation into the thoracic cavity; (4) contralateral shift of mediastinum; and (5) coiled Ryle's tube in the left thoracic cavity. However, associated pleural effusion and lung contusion may mimic a few of the findings. Ultrasonogram may show the presence of bowel loops in the thoracic cavity.

CT scan has a sensitivity of 50% for right-sided tears and 78% for left-sided tears.⁵ CT findings in case of a diaphragmatic tear are focal discontinuity of diaphragm and herniation of bowel loops or solid viscera into the thoracic cavity with a constriction of the viscera at the point where it passes the tear (collar sign).

Figure 2 CT pleurogram images after instillation of contrast through intercostal tube: (A and B) are coronal reformatted images in bone window and (C and D) are axial images in soft tissue window. Contrast is seen on either side of the left dome of the diaphragm, depicting the arched nature of the diaphragm (arrows in A), a few slices posterior to this, a defect is seen in the lateral aspect of the diaphragm (arrow in B) as a contrast filled conduit connecting the pleural space and peritoneum. Contrast is seen filling the greater sac (arrows in C), lesser sac (asterisk in D) and is also seen entering the crevice formed by the pancreatic laceration (arrow in D).

MRI depicts small diaphragm injuries and intact normal diaphragm with high sensitivity.⁶ In T1 imaging, the diaphragm appears hypointense in-between the hyperintense mediastinal and omental fat. However, MRI with its longer scan time and breath hold times limits its use in emergency situations.

Nearly 50% of diaphragmatic injuries are missed initially,⁷ mainly due to the following reasons:

- ▶ Diaphragm is very thin and has a complex arched architecture making it impossible to visualise in a single plane. So direct visualisation of the defect is difficult.
- ▶ Only larger tears result in abdominal viscera herniation and contralateral mediastinal shift. Smaller tears, without any obvious findings, are almost always missed.

A missed diaphragm tear can gradually lead to herniation of bowel loops, which may end up in obstruction, strangulation or rupture and may present with life-threatening emergency.⁸ A high degree of suspicion is needed to diagnose an occult diaphragmatic tear. Thoracoscopy has a high sensitivity of 98–100% in diagnosing diaphragm injuries and is used when laparotomy is not contemplated.⁸

When the patient has an intercostal tube in situ, a CT pleurogram may be performed to accurately demonstrate even a small diaphragmatic tear, as shown in our case. A literature search revealed no instance of a CT pleurogram reported so far. However, X-ray pleurograms using lipidol contrast have been used in the past for identifying diaphragm breach in pancreatitis,⁹ delineation of empyema cavity¹⁰ and in diagnosis of bronchopleural fistula.¹¹ A CT pleurogram can be performed

easily and interpreted without much difficulty, and can reveal the presence of a diaphragmatic tear, the site and size of the tear and, in cases such as ours, the organ of origin of the fluid can also be demonstrated.

Treatment

Surgical evaluation of the diaphragm by laparotomy remains the gold standard in diagnosis.⁸ Even small tears need to be repaired to avoid the possibility of delayed complications. Exploration can be carried out via the thoracic or abdominal route. Small tears are sutured and large tears require prosthetic mesh implantation. A delay in diagnosis of the tear will result in a difficult or failed surgery as adhesions and diaphragm atrophy develop.⁸

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Competing interests None.

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Learning points

- ▶ The typical features of diaphragmatic tears, such as abnormally high diaphragm, herniated viscera and disrupted diaphragm contour, are only seen in cases of large tears.
- ▶ Small tears can be missed in X-ray and CT, and can lead to gradual herniation of bowel loops, which may end in strangulation, obstruction or rupture, with dire consequences.
- ▶ When the patient has an intercostal tube in situ, a CT pleurogram can be performed to reveal the presence and location of a diaphragmatic tear.

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