

RUPTURE OF DIAPHRAGM AFTER NON-PENETRATING INJURY

By Hussein Bin Mohamed Salleh

SYNOPSIS

Three cases of diaphragmatic rupture due to blunt injury are presented. Delay in diagnosis and therefore in treatment can lead to complications and death. The greatest aid to diagnosis is awareness of the condition. Treatment is by immediate surgery following adequate resuscitation and involves a secure repair of the diaphragmatic tear after reducing displaced abdominal viscera.

A tear may occur in the diaphragm after blunt injury to the abdomen or chest. Intra-abdominal viscera may herniate through the diaphragmatic defect, thereby interfering with cardio-respiratory mechanics, whilst the herniated viscera themselves are liable to strangulation.

CASE REPORTS

Case 1

An eight year old boy was admitted after a car accident. On examination, he was in shock and there was guarding and rigidity of the left upper quadrant of the abdomen. Peritoneal tap yielded 50 millilitres of blood from this area. A plain abdominal radiograph (Fig. 1) showed that the stomach had herniated into the left lower chest. A diagnosis was made of a ruptured left hemi-diaphragm with a possible splenic injury. At operation, a left paramedian abdominal incision was made and this revealed that the spleen and stomach had herniated into the left hemithorax through a ten centimetre tear in the periphery of the left hemi-diaphragm. These organs were reduced into the abdominal cavity. The diaphragmatic tear, which was of recent onset, was repaired in two layers, interrupted silk sutures through the full thickness of the diaphragm and interrupted silk sutures through the diaphragmatic peritoneum. The spleen was removed as there was a small bleeding laceration at the hilum. Post-operatively, the patient made a good recovery and was discharged in a fit condition.

Case 2

stomach was in the chest. A gastrograffin meal radiograph was done and this showed a dilated stomach much of which was in the chest (Fig. 2). At operation, a left paramedian abdominal incision was made and it was found that the stomach had her-



Fig. 1. Case 1—Plain abdominal radiograph. The stomach air shadow is seen in the lower part of the left hemithorax.

niated through a four centimetre tear in the dome of the left hemidiaphragm. The stomach was reduced into the abdomen. The diaphragmatic tear, which was of long-standing with fibrotic edges, was repaired in two layers using silk sutures. Unfortunately, the patient did not regain consciousness and died ten hours post-operatively.

Case 3

This was a 21 year old male patient who had a splenectomy done for a ruptured spleen due to a car accident. In retrospect, it was recalled that the dia-

Reprints: Mr. Hussein Bin Mohamed Salleh, F.R.C.S. (Ed)
Consultant Surgeon and Head Unit 3
Department of General Surgery
General Hospital, Kuala Lumpur, Malaysia.



Fig. 2. Case 2—Gastrograffin meal radiograph. The stomach is partly in the chest.

phragm was not inspected at the original operation. Two weeks later, he developed a left subphrenic abscess and this was followed ten days later by a left pyo-pneumothorax. A thoracotomy through the bed of the left eighth rib revealed air and pus in the left chest. There was also an old-standing tear in the dome of the left hemi-diaphragm and a left sub-phrenic abscess in this area. Infection and pus had developed in the area of the bed of the spleen after the splenectomy and the pus had tracked upwards through the diaphragmatic tear into the left pleural cavity forming a pyo-pneumothorax. The abscesses were drained and the tear repaired. Subsequently, the patient made a satisfactory recovery.

DISCUSSION

The greatest aid in the diagnosis of diaphragmatic rupture is to be aware of the condition as happened in Case 1. It must be assumed that after any injury to the chest or abdomen, the diaphragm may rupture. It is possible to make the diagnosis clinically by such symptoms and signs as dyspnoea which is made worse by lying down, abnormal gurgling sounds, reduced movement and a dull percussion note in the affected hemithorax. All these signify that there is herniation of intra-abdominal viscera into the chest. A radiograph of the chest is valuable as it may show the air in an intra-thoracic stomach or intestine. For obscure cases, a barium or gastro-

graffin meal radiograph will outline an intra-thoracic stomach. As an aid in diagnosis, air may be introduced into the peritoneal cavity and if this results in a pneumothorax, then there is a tear in the diaphragm. This is especially useful in the diagnosis of a right hemidiaphragm tear. However, this technique of induced pneumo-peritoneum is not without danger and it may give rise to false negative results. At laparotomy for an intra-abdominal injury, it is essential to inspect the diaphragm for any tear. This was not done in Case 3 and a diaphragmatic tear which was present at the original injury was thereby not diagnosed.

Knight and McCook (1960) recognised three phases in the development of a diaphragmatic hernia, namely:—

A post-traumatic phase—where there may be no symptoms and signs or the symptoms and signs may be non-specific. Other injuries often mask the symptoms and signs which might suggest traumatic rupture of the diaphragm.

An interval phase—this can also be asymptomatic or else over the next few days to weeks after the injury, gastro-intestinal or respiratory or cardiac symptoms and signs may arise. These include nausea, vomiting, dyspnoea, tachycardia, cyanosis, restlessness or substernal pain which may be referred to the shoulder. These symptoms and signs may be intermittent. Case 3 comes into this category and is unusual in that a left pyo-pneumothorax arose from infection in the splenic area after a splenectomy.

The late phase—this includes intestinal obstruction, strangulation or haemorrhage and may occur suddenly after many years. Atelectasis with resulting pneumonitis of the lower lobe of the lung may cause chronic respiratory difficulty. Gaseous distension, pain, muscle spasm, nausea and vomiting may promote incarceration of the herniated abdominal viscera at any time. Haemorrhage secondary to strangulation may occur. Case 2 comes into this late phase category as the patient had the original injury two years previously.

Bernatz *et al* (1958) recognised a fourth group of patients who were in desperate trouble within a few hours due to deranged cardio-respiratory function precipitated by the presence of distended abdominal contents in the pleural space.

Due to the protective effect of the underlying liver, rupture of the right hemidiaphragm is rare compared with the left side. Bilateral rupture, that is, simultaneous rupture of the right and left hemidiaphragm, is very rare (Manlove and Baronifsky, 1955). An actual tear of the crura of the diaphragm is exceedingly rare (Weisel, 1966) and should be distinguished from post-traumatic oesophageal hiatal hernia. The crura are strong solid structures which withstand trauma quite well. However, the oesophageal hiatus itself, with its phrenico-oesophageal membranes, does not have the strength of the crura

or the rest of the diaphragm. Thus, herniation through the hiatus may be caused by severe compression of the thorax or abdomen. It is important to be certain of the absence of a pre-existing hiatal hernia before ascribing the hernia to trauma (Hill, 1972). Tears of the central tendon of the diaphragm are rare and may result in an intrapericardial hernia causing cardiac tamponade.

It is likely that many factors act to cause diaphragmatic rupture—increased intra-abdominal pressure due to the blow, a further increase in the pressure gradient across the diaphragm as the latter contracts, distortion of the contracted hemidiaphragm and possibly a localised congenital or degenerative weakness in the diaphragm (Salleh, 1973).

Operative repair of the diaphragmatic rupture should be carried out as soon as possible after appropriate resuscitative measures, regardless of the stage at which the patient presents. This is because in addition to interference by herniated viscera with the function of the heart and lungs, there is always the possibility that the displaced viscera would incarcerate and strangulate. Carter and Giuseffi (1948) indicated that 90 per cent of strangulated hernias are traumatic in origin. Before the operation, it is important to pass a gastric tube and decompress the stomach. This will, temporarily at least, reduce the pressure effects on the heart and lungs and also reduce the possibility of aspiration of gastric contents during induction of the general anaesthesia. The greatest danger of induction in these cases is, however, cardiac arrest since the heart which is already displaced and compressed by the contents of the hernia, is further embarrassed by the inflation of the lungs when positive pressure ventilation is used. It is preferable to use an abdominal incision to approach the lesion because at the same time, intra-abdominal viscera may be inspected. The incision can be extended to an abdomino-thoracic one if there is difficulty in reducing the herniated gut back into the abdomen. For right hemi-diaphragm tears, it is best to do a thoracotomy incision originally since the liver would obstruct access to the lesion if an abdominal incision were made first. The thoracic incision could be extended to a thoraco-abdominal one for better exposure. It is essential to repair

the diaphragmatic tear securely and late disruption of the repair is a serious complication (Keshishian and Cox, 1962). A satisfactory repair can be made by applying two layers of non-absorbable sutures, such as silk, to the edges of the tear. The first layer of sutures passes through all layers of the diaphragm whilst the second layer goes through the diaphragmatic peritoneum. If the tear is too wide to suture without tension, then a piece of pericardium or synthetic prosthesis may be used to bridge the gap.

SUMMARY

Three cases of diaphragmatic rupture due to blunt injury have been presented. Delay in diagnosis and therefore in treatment can lead to complications and death. The greatest aid to diagnosis is awareness of the possibility of the condition. Treatment is by immediate surgery after adequate resuscitative measures.

ACKNOWLEDGEMENTS

I thank Tan Sri Datuk (Dr.) A.M. Ismail, F.R.C.S. (Ed); M. Ch.(Orth.); F.R.A.C.S., Director General of Health Services, Malaysia, for his kind permission to publish this article. I am grateful to Dr. M. Krishnan for allowing me to report Case 3. My thanks go to Miss Ng Fei Fei for typing the manuscript.

REFERENCES

1. Bernatz, P.E., Burnside, A.F., Jr. and Clagett, O.T.: Problem of the rupture diaphragm. *J.A.M.A.*, 168: 877, 1958.
2. Carter, N. and Giuseffi, J.: Strangulation diaphragmatic Hernia. *Ann. Surg.*, 128: 210, 1948.
3. Hill, L.D.: Injuries of the diaphragm following blunt trauma. *Surg. Clin. N. Amer.*, 52: 611, 1972.
4. Keshishian, J.M. and Cox, P.A.: Diagnosis and Management of strangulated diaphragmatic hernias. *Surg. Gynec. Obstet.*, 115: 628, 1962.
5. Knight, C.D. and McCook, W.W.: Traumatic diaphragmatic hernia. *Amer. Surgeon.*, 26: 656, 1960.
6. Manlove, C.H. and Baronifsky, I.D.: Traumatic rupture of both leaves of diaphragm. *Surgery*, 37: 461, 1955.
7. Salleh, Hussein Bin Mohamed: Diaphragmatic rupture due to blunt trauma. *Br. J. Surg.*, 60: 430, 1973.
8. Weisel, W.: Trauma and the cavity barrier. *Surg. Gynec. Obstet.*, 123: 1081, 1966.