Case report

Pericardio-diaphragmatic avulsion and concomitant rupture of the central tendon of the diaphragm

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Abstract

Two patients, treated for blunt thoracoabdominal trauma with ruptured diaphragm and concomitant avulsion of the pericardial sac in its entirety from the central tendon of the diaphragm, are presented. We do not think this entity has been reported before. We explain this type of lesion on the basis of embryological development of the pericardium at the level of the central tendon of the diaphragm.

Keywords: Diaphragm; Trauma; Blunt; Rupture; Pericardium

1. Introduction

Approximately 2.5% of patients who sustained thoracoabdominal trauma (TAT) suffer from diaphragmatic rupture [3,5]. Diaphragmatic ruptures are described as unilateral, bilateral, or intrapericardial. The entity of pericardio-diaphragmatic avulsion whereby the pericardial sac as a single intact unit is avulsed in its entirety from the central tendon of the diaphragm is unusual. With it, a concomitant tear in the central tendon was repaired.

2. Case 1

A 17-year-old male road traffic accident patient was admitted, resuscitated, intubated, and a left-sided intercostal drain (ICD) inserted, for management of a head injury and blunt TAT with white-out of his left hemithorax. The left-sided ICD only drained a minimal amount of blood stained fluid. A CT head, neck, chest and abdomen revealed diffuse brain oedema, four left-sided rib fractures, colon and stomach in the left pleural cavity and a ruptured spleen.

At laparotomy a splenectomy was performed along with a repair of a 20 cm tear in the left diaphragm.

The tear in the central tendon stretched from the IVC on the right, antero-laterally, in a transverse direction, ending in the left muscular diaphragm (Figs. 1 and 2). Except for a bleeding vein in the torn ligamentum falciforme there was no bleeding in the diaphragm itself. The hiatus was intact being much more posteriorly located. Through the tear looking in a cranial direction the pericardial sac was clearly visible, avulsed and detached from the central tendon and integer, with no breach in it, and at palpation no pericardial effusion. The phrenic nerves were not involved in the traumatic process, being more lateral and more posteriorly located. The diaphragmatic aspect of the pericardium was rough and looked like a torn tendon. The heart was contracting normally, which was corroborated by the normal ECG, arterial and venous pressure tracings with no signs of tamponade. The tear was repaired with a double running Ethibond 2 (Ethicon W4843) suture making sure to hitch up and fix the avulsed pericardial sac to the repaired diaphragm. The pericardium was not drained.

The postoperative course was complicated by a total collapse consolidation of the left lung for which a bronchoscopy was needed. His 3-month postoperative chest X-ray showed a normal diaphragm!

3. Case 2

A 17-year-old male patient underwent a laparotomy for repair of a ruptured bladder and urethra secondary to a blunt TAT with fractured pelvis. At exploration an undiagnosed ruptured diaphragm was found. A tear starting in the right
Muscular hemi-diaphragm stretched anteriorly to the IVC laterally across the dome of the central tendon into the left muscular hemi-diaphragm (Fig. 2).

On further inspection through the torn central tendon an avulsed pericardial sac could be seen separate from the diaphragm itself. The sac was intact and its diaphragmatic side again had the aspect of a torn tendon. The hiatus was intact and not involved in the pathological process. There was clinically no intrapericardial fluid present. The ECG showed signs of ST-segment elevation but the patient maintained his central and peripheral arterial pressures within normal limits until he developed acute signs of massive retro-peritoneal bleeding for which immediate stabilisation of the pelvis was done after the diaphragm had been repaired by means of a double running Ethibond 2 (Ethicon W4843) suture. Again care was taken to incorporate the inferior aspect of the pericardial sac into the suture-line of the repaired diaphragm. As in the first patient there was no need for a pericardial drain. His postoperative recovery was more complex in view of his associated injuries. His 4-month postoperative chest X-ray revealed a diaphragm in a normal position.

4. Discussion

Blunt thoracoabdominal trauma can lead to rupture of the diaphragm [1,3,5]. Unusually both our patients presented with concomitant avulsion of the pericardium from the diaphragm. The pericardial sac was intact but independent of the diaphragm to such an extent that it had to be ‘hitched’ onto the diaphragm when the repairs were being effected at laparotomy. Both the left and right phrenic nerves were not involved in the injury which explained the normal postoperative aspect and functioning of the diaphragm at follow-up. Indeed the avulsion process stopped anterior to the point of entry where both the left and right phrenic nerves joined the diaphragm. This type of injury we think has not been reported before. As is well recognised the severity of the trauma is related to the associated injuries rather than the tear itself. The diagnosis is often overlooked. In principle acute ruptures are best approached through laparotomy to allow associated injuries to be dealt with and chronic ruptures are best dealt with via a thoracotomy to avoid difficulties resulting from adhesions and their dissections [1,3–6]. In both patients the morbidity was determined by the associated injuries and the discovery of the rupture at laparotomy in case 2 is not unusual either.

Diaphragmatic tears are usually described as being left, right, bilateral or intrapericardial [1,4,6].
A pericardio-diaphragmatic dehiscence or avulsion in association with a tear of the diaphragm is a new entity. Review of the embryology of the diaphragm and the pericardium does explain the pathophysiological mechanism of the pericardio-diaphragmatic dehiscence in these two cases [1,2].

The plane of dehiscence or avulsion of the pericardium from the diaphragm would be a ‘congenital’ weakness in the area of contact between the septum transversum and the ‘inferior’ or ‘diaphragmatic’ part of the pericardial sac at level of the central tendon.

The septum transversum is a single midline mesodermal unit separating the pericardial sac and peritoneal coelom. The pericardial sac, an entity separate and prior to the formation of the septum transversum consists of a single layer of squamous epithelium (mesothelium) supported by a layer of connective tissue [2]. Somehow the layer of pericardial connective tissue and the mesoderm of the septum transversum have to ‘fuse’ at the level of the diaphragmatic part of the pericardium. This could be indeed a plane of weakness explaining the dehiscence of the ‘diaphragmatic’ pericardium, at that level, from the central tendon of the diaphragm. As such the diaphragm would be sliced in a superior or pericardial part and an inferior or diaphragmatic component.

It thus made sense to close the torn diaphragm and hitch the pericardial sac onto the central tendon.

At follow-up both patients had normal functioning diaphragms and had fully recovered from their associated injuries.

5. Summary

Two patients who were involved in the same accident were admitted with massive thoraco-abdominal blunt injuries. Both suffered from a ruptured diaphragm and avulsion of the pericardial sac from the central tendon of the diaphragm. The morbidity was related to the associated injuries.

We do not think avulsion of the pericardial sac from the central tendon with a concomitant tear of the diaphragm has been described previously and propose a pathophysiological mechanism on the basis of the embryological development of the central tendon of the diaphragm and the formation of the pericardial sac.

References