Blunt traumatic rupture of the diaphragm: Study of 33 cases

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ABSTRACT

Objective: to assess the role of clinical manifestations and radiological findings in the early recognition and diagnosis of blunt diaphragmatic rupture, with determination of the operative findings during surgical intervention.
Design: a prospective case series study.
Setting: Al-Jamhori Teaching Hospital in Mosul, during the period July 1999-June 2004.
Participants: thirty three (33) patients with blunt traumatic rupture of the diaphragm proved by surgery.
Results: three quarters of the blunt diaphragmatic rupture were caused by motor vehicle accidents, 91% of the patients had respiratory embarrassment. Only 27.2% of the patients were diagnosed by chest x-ray, the remaining 72.8% were discovered during laparotomy. The left dome of the diaphragm was ruptured in 75.8%, whereas herniation of the abdominal viscera into the chest was found in 45.8%. Concomitant intra-abdominal injury was found in 84.8% of the patients. The mortality is sharply increased when the right dome of the diaphragm is ruptured.
Conclusion: the clinical features may be masked by other chest or abdominal injuries. Chest-x ray is a reliable test to diagnose diaphragmatic rupture. The left hemi-diaphragm is more commonly injured; in addition concomitant intra- abdominal injuries are very common. A meticulous inspection of the diaphragm should be undertaken during all exploratory laparotomies for trauma.

الخلاصة

أهداف البحث: تقييم الأعراض السريرية والفحص الشعاعي في تشخيص حالات تمزق الحجاب الحاجز عند الإصابة غير النافذة للبطن.وتحديد موقع التمزق في الحجاب الحاجز، وتحديد الإصابات الأخرى في داخل البطن، ونسبة الوفيات.
التصميم: دراسة مستقبلية لمجموعة من الحالات.
مكان إجراء البحث: مستشفى الجمهوري التعليمي، تموز 1999- حزيران 2004.
المشاركون: ثلاثة و ثلاثون مريضا أصيبوا بشدة غير نافذة على البطن أو أسفل الصدر، ثبت باستكشاف البطن الجراحي أنهم مصابون بتمزق الحجاب الحاجز.
النتائج: ثلاثة أرباع المصابين بتمزق الحجاب الحاجز كان نتيجة حوادث الطرق، 91% من المصابين كانو يشكون من الألم الصدر أو ضيق في التنفس. تم تشخيص 27.2% من المرضى عن طريق أشعة الصدر، وتم تشخيص الباقي عن طريق الاستكشاف الجراحي. الجزء الأيسر من الحجاب الحاجز كان الأكثر تعرضا للإصابة بنسبة 75.8% من الحالات، كما وجد تفتق أعضاء من البطن إلى الصدر بنسبة 45.8% من الحالات. وأن هناك 84.4% من الحالات كان يوجد أعضاء مصابة أخرى داخل البطن. كما وجد أن نسبة الوفيات تزداد كثيرا عند اصابة الجزء الأيمن من الحجاب الحاجز عما هو عليه عند إصابة الجزء الأيسر فقط.
الاستنتاج: تمزق الحجاب الحاجز يشكل خطورة على حياة الإنسان، لأنه صعب التشخيص بالاعتماد على الأعراض السريرية فقط، وقد يؤدي إلى تفتق أعضاء البطن إلى الصدر والتي يمكن تشخيصها بالفحص

الشعاعي، إضافة إلى احتمال كبير لوجود اصابات أخرى إضافية في البطن.كما وجدنا أن إصابة الجهة اليسرى أكثر من الجهة اليمنى وأن تكهن حالات الوفيات فيها أفضل. لذلك فان توقع الإصابة بتمزق الحجاب الحاجز يجب أن يؤخذ بنظر الاعتبار في حالات الشدة غير النافذة على البطن. وان يتم تفحص الحجاب الحاجز أثناء إجراء عملية استكشاف البطن.

Blunt rupture of the diaphragm is no longer uncommon, and its incidence has risen sharply, with the increase in high speed accidents from motor vehicle collisions[1]. However, the mechanism for diaphragmatic rupture (DR) is high speed blunt abdominal trauma with a closed glottis[2]. DR should be suspected in patients with blunt injury of the abdomen and /or chest particularly of the epigastrium and lower chest[3].

Clinically, the patient may present with vague symptoms, as dyspnea, chest pain, and cyanosis[1,4]. The diagnosis of acute DR is difficult to establish in the immediate posttraumatic period[5-7], due to obscuration caused by overlying pulmonary and other concomitant abdominal injuries[7,8]. In addition the fact that most patients with DR usually have sustained additional multiple traumatic injuries elsewhere in the body, does also play a role in diverting attention in more than one site as to allow more likelihood for missing DR.

In fact, it has been stated that DR should be suspected in all patients with radiological abnormalities of the diaphragm, lower lung field haziness, hemothorax, or displacement of abdominal organs[3-5,9,10]. In the absence of other indications for immediate surgery, blunt DRs are easily missed since radiological abnormalities of the diaphragm, particularly those involving the right hemidiaphragm are often interpreted as thoracic trauma[6,8]. However, chest x-ray remains the most beneficial test for diagnosing DR[5,9]. All cases of DR, weather diagnosed pre-operatively or intra-operatively, must be repaired surgically, in order to avoid long term sequel[3,4]. The presence of DR should be excluded before the termination of an exploratory procedure in such circumstances[3]. Delay in the recognition of DR can be life threatening since it can lead to herniation of abdominal viscera into the thorax with possible strangulation or respiratory embarrassment[7,8].

This study aims to assess the clinical and radiological features that contribute to the early recognition and diagnosis of DR, on evaluating patients subjected to blunt abdominal trauma. It also aims to determine the method of treatment, the exploratory findings, and the concomitant intra-abdominal injuries.

Patients and methods

Over a five-year period (July 1999- June 2004), all patients diagnosed and surgically treated for blunt diaphragmatic rupture (DR) who were admitted to the three surgical units in Al-Jamhori Teaching Hospital in Mosul, were studied concerning, clinical manifestations, radiological studies, surgical findings and mortality.

On admission, all these traumatized patients were assessed clinically for signs of acute abdomen (pain, tenderness, guarding, and rigidity), and examined for any injury to other parts of the body, to exclude head injury, pelvic injury, or fractures and wounds; in addition, most of the patients had undergone chest film examination to exclude thoracic injury. All patients radiologically proved to have DR were evaluated for the presence of chest pain, shortness of breath, and respiratory distress; whereas patients surgically proved to have DR were interrogated postoperatively for chest pain, shortness of breath, and respiratory distress.

According to the clinical and radiological assessment, the patients were either subjected to emergency laparotomy, or kept on conservative management. All patients who were kept initially on conservative therapy (the delayed group) were all operated on within 36 hours after admission to the hospital because of either developing signs of peritonitis or radiological evidence of visceral herniation into the chest.

Verification of the diagnosis of DR in all patients was performed after surgical intervention. All surgical findings regarding the diaphragmatic tear, the herniated viscera, and other associated intra-abdominal injuries were recorded. All

patients were followed up until discharge from the hospital or death.

Results

Thirty three patients with blunt trauma, have undergone surgical repair of the diaphragm during exploratory laparotomy. Twenty five (75.8%) of them had sustained motor vehicle accidents, 5 (15.2%) patients were due to direct violence to the abdomen, the remaining 3 (9%) had fallen from height.

On admission, 30 (91%) patients had respiratory symptoms as chest pain, dyspnea, or respiratory distress, whereas, 21(63.6%) patients had signs and symptoms of acute abdomen. In addition, all patients had associated extra-abdominal injuries as shown in table (1).

Twenty nine patients underwent chest-x ray on admission, five (17.2%) of these were diagnosed as DR, because they had radiological evidence of visceral herniation into the chest, 11(38%) patients had no detectable radiological abnormality, in the remaining 13(44.8%) patients non-specific radiological abnormalities such as haziness, hemothorax, or elevated diaphragmatic dome were encountered.

Twenty six (78.8%) patients were subjected to emergency laparotomy within six hours of admission, because of signs of acute abdomen in 21 patients, and radiological evidence of DR in 5 patients. The remaining 7(21.2%) patients (the delayed group) were submitted to a second chest-x ray while maintained on conservative management, 4 of them had shown radiological evidence of herniated abdominal viscera into the chest; the remaining three patients developed signs of peritonitis, two of them within 24 hours, and within 36 hours in one patients.

Only nine (27.2%) patients were diagnosed as DR on radiological bases pre-operatively, the rest, 24 (72.8%) patients were found to have DR, incidentally on exploration for acute abdomen.

During surgery, 25(75.8%) patients were found to have left sided DR, 6 patients had right sided DR, the remaining two had bilateral rupture of the diaphragm. Herniation of abdominal viscera into the thoracic cavity was encountered in 15 (45.4%) patients, in 14 of them was on the left side, the stomach being the most common herniated organ as in table (2). Only one patient had a herniated liver into the right thoracic cavity.

In 26 (78.8%) patients, a radial tear in the dome of the diaphragm was found. Whereas, in 7 (21.2%) cases the diaphragm was nearly avulsed from the thoracic cage with remnant of about 1centimeter, in 5(15.2%) patients it was situated posterolaterally, and in 2 (6%) cases it was anterolaterally

Twenty eight (84.8%) patients were found to have concomitant intra-abdominal injuries as shown in table(2). In the remaining 5 (15.2%) patients, no other intra-abdominal injury was encountered apart from the diaphragmatic rupture.

Six (18%) patients died within 1-6 days after surgery, two of them had bilateral DR with severe hepatic injuries and other associated abdominal or thoracic injuries. Three patients out of the six with right DR were died for the same reason, but, only one patient with left sided DR died, due to septicemia with subsequent uremia.

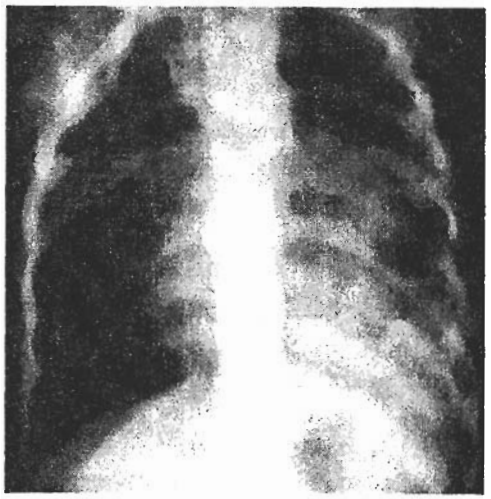
In other words, the mortality rate was 100% for patients with bilateral DR; 50% for right hemi-diaphragmatic rupture; and only 4% among those with left sided DR.

Table (1): *The extra- abdominal associated injuries.*

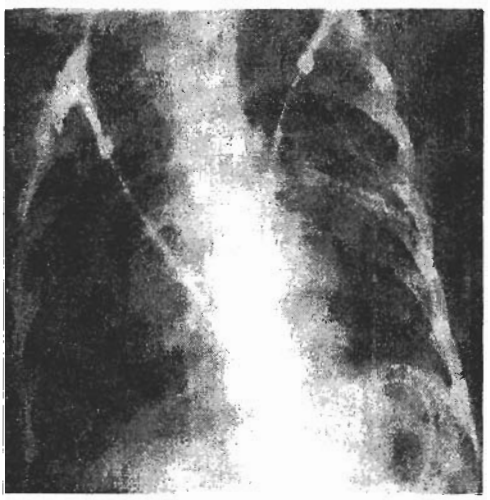
Organs injured	Head injury	Thoracic injury	Pelvic injury	Wounds	Fractures
No.	16	24	6	27	8

Table (2): *The number of organs herniated and the concomitant intra- abdominal injuries.*

Organ	stomach	spleen	colon	omentum	liver	mesentery	kidney	retroperitoneal
No. of Herniations	12	1	2	4	1	–	–	–
No. of injuries	2	17	1	–	9	6	2	5



Figure(1): *Preoperative chest x-ray demonstrating herniation of the viscera into the chest.*



Figure(2): *Postoperative chest x-ray.*

Discussion

In this study, motor vehicle accidents (MVA) stood as the commonest cause (75.8%) of blunt diaphragmatic rupture in conformity with the report of Voeller et al[4], and Harmas et al[11], where (MVA) was the main cause in 90% and 77% respectively. This is ascribed to the increase in the high speed accidents from motor vehicle collision[1].

Thirty (91%) of our DR patients had respiratory manifestations, in the form of chest pain, dyspnea, and respiratory distress, which stand as an important pointer to the possibility of DR. However, Rodrigues et al[12], stated that 52% of his patients with DR had respiratory manifestations. This may be attributed to the 21 (63.6%) patients with a positive respiratory manifestation who were postoperatively interrogated. Likewise, respiratory manifestations of DR are variable and unpredictable specially in massively traumatized patients[9]. However, the diagnosis is frequently missed in the acute phase, because of the presence of shock, respiratory insufficiency, visceral injury, or coma[2].

In our study, we did not recognize respiratory embarrassment as diagnostic for DR, unless it was supported by chest x- ray, because it may be ascribed to direct trauma to the chest, shock state, or referred pain from the abdomen. But when respiratory manifestations develop after a severe blow to the abdomen without clinically evident trauma to the chest, the diagnosis of DR has to be contemplated[13], and should be sought radiologically or surgically.

In our study, the pre-operative diagnosis by chest-x ray was achieved in 9 (27.2%) patients, in other studies it ranged between (24-62%)[4,5,9,11,12,14-16]. However, DR can be diagnosed radiologically only if herniated stomach or bowel is constricted as it transits the torn diaphragm[2].

Although non-specific radiological findings were encountered in 13(44.8%) of the 29 patients who underwent initial chest-x ray on admission, they were either unpredictable or misinterpreted; such findings justify repeating the chest-x ray rather than ignoring it. This will demonstrate the potential pitfalls of misinterpreting the chest radiograph, and the value of repeating it[1]. However, a prompt recognition of this potentially life threatening injury is difficult when the initial chest-x ray is unrevealing, and immediate or early operation is not done[17].

In our study, we found that 24 (72.8%) of DR patients, were discovered during abdominal exploration for acute abdomen, but in their reports, Guth et al[17] stated that (42%) of the patients with DR were discovered at time of laparotomy.

Isolated affection of only the left dome of the diaphragm with blunt injury is clearly more common than that of the right dome, which was reported as (75%) in two reports[15,18], which is very similar to the present series (76%); one single report stated it as (56%)[4], but most reports stated that left sided rupture was (57-87%)[5]. The high prevalence of left dome injury suggests that blunt trauma that

exerts an equal impact on both domes of the diaphragm carries a higher likelihood to injure the left dome; however, this is due to the protective effect of the liver to the right dome[5]. Thus the left dome of the diaphragm is more vulnerable to rupture by blunt trauma; moreover, it carries in this report a much better prognosis than right sided rupture, (4%) and (50%) mortality rate respectively. It is tempting to link the higher prevalence and the better prognosis of left sided blunt DR to a relatively less severe impact of the blunt trauma, which leads to milder lesions or less severe damage to the affected organ.

These patients usually have severe multi-system injuries because of the large force required to rupture the diaphragm[1]. In this study, all patients were found to have extra-abdominal injuries, and (85%) of them had associated intra-abdominal injuries, the spleen was the commonest injured organ in (51.5%); other reports stated that the associated intra-abdominal injuries occurred in (77-96%) of the cases[11,12,19].

We found that 15(45.5%) patients had herniation of abdominal organs into the chest, the stomach being the most common organ (36.3%). Ilgenfritz et al[15], stated that (67%) of the cases had intra-thoracic herniation, the stomach was herniated in (54%), whereas, only (32%) of the cases had intra-thoracic abdominal organs herniation, as stated by Rodrigues et al[12]. Only 9 (27.2%) patients among those with intra-thoracic herniation of abdominal organs were diagnosed by chest-x ray, the rest were discovered during exploration. This may be ascribed to delayed herniation of abdominal organs into the chest[13], or might have been obscured by hemothorax[10].

The high mortality of the isolated injury of the right hemi-diaphragm, and more interestingly the (100%) mortality of patients with bilateral rupture of the diaphragm can be interpreted as caused by a more severe traumatic impact than in isolated left sided DR. However, the liver injury with uncontrollable exanguinating hemorrhage from the hepatic vessels[20], can not be denied as a contributor to the high mortality rate, which in our study, have been encountered in two cases with severely smashed liver.

The mortality rate is generally dictated by the magnitude of associated injuries rather than that of the diaphragm[5]. Moreover, affection of the extra-abdominal and/or associated intra-abdominal organs is likely to be the main cause that increase the incidence of the mortality rate.

In ***conclusion:*** diaphragmatic rupture represents a challenge to the surgeon, although it is not uncommon after blunt trauma. The presence of respiratory features with suspicious chest-x ray remains the best diagnostic index, therefore chest-x ray is advisable for every patient with blunt trauma.

The left diaphragmatic rupture is more common, and had better prognosis than the right one, in addition associated extra-abdominal and intra-abdominal injuries are extremely common.

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