

Prognostic factors and outcome of traumatic diaphragmatic rupture

Travmatik diyafragmatik rüptüründe prognostik faktörler ve sonuçlar

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BACKGROUND

Traumatic diaphragmatic hernias commonly occur after blunt and penetrating trauma. The difficulties in diagnosing traumatic diaphragmatic rupture due to coexisting injuries and the silent nature of the diaphragmatic injuries at the first admission are the most common causes of delayed diagnosis.

METHODS

The medical records of 34 patients (28 male, 6 female; mean age 32.3 years; range 1 to 68) treated for post-traumatic diaphragmatic hernias between August 2004 and June 2008 in Alzahra Hospital were analyzed retrospectively.

RESULTS

Rupture of the diaphragm was left-sided in 22 (64.7%) and right-sided in 11 (32.4%) and bilateral in 1 (2.9%) of the patients. Blunt trauma accounted for the injuries of 22 patients (64.7%). In the first operation, diagnosis was established preoperatively in 15 patients (44.1%) and intraoperatively in 13 (38.2%). The diagnosis was missed in 6 (17.7%) patients in the first operation. Strangulation of the viscera was seen in three patients. The longest interval between the onset of trauma and diagnosis was approximately three years in one case. Multiple associated injuries were observed in 22 patients (64.7%), the most common of which were spleen injury (38.2%), fractures of the extremities and hemothorax (29.4%) and liver injury (26.5%). Postoperative complications were seen in nine patients (26.5%). Mortality of isolated blunt traumatic rupture was 0%. Hemorrhagic shock, young age and associated injuries significantly increased the mortality and morbidity.

CONCLUSION

Despite the fact that the incidence of diaphragmatic hernia is uncommon, it should be suspected in all blunt or penetrating traumas of the thorax and abdomen. Because late complications are usually associated with high morbidity, the presence of such an injury should be excluded before terminating the exploratory procedure.

Key Words: Diaphragmatic hernia; laparotomy; thoracotomy; trauma.

AMAÇ

Travmatik diyafragma fitıkları, künt ve penetran yaralanmalardan sonra sıklıkla oluşmaktadır. Travmatik diyafragma yırtığı tanısında zorluklar, eşlik eden yaralanmalar ve diyafragma yaralanmalarının sessiz doğası ilk başvuruda geç tanı konmasının en sık nedenleridir.

GEREÇ VE YÖNTEM

Alzahra Hastanesi'nde Ağustos 2004 ile Haziran 2008 tarihleri arasında post-travmatik diyafragma fitığı nedeniyle tedavi edilen 34 hastanın (28 erkek, 6 kadın; ortalama yaş 32,3 yıl; dağılım 1-68) tıbbi kayıtları, retrospektif olarak incelendi.

BULGULAR

Diyafragma yırtığı hastaların 22'sinde (%64,7) sol tarafta, 11'inde (%32,4) sağ tarafta ve 1'inde ise (%2,9) iki taraflıydı. Künt travma, 22 hastada yaralanma (%64,7) nedeniydü. İlk operasyonda tanı, 15 hastada (%44,1) ameliyat öncesinde, 13 hastada (%38,2) ameliyat sırasında koyuldu. Tanı, 6 hastada (%17,7) ilk operasyonda atlandı. Üç hastada, viseral organ strangülasyonu görüldü. Travma başlangıcı ile tanı arasındaki en uzun interval, bir olguda yaklaşık üç yıl oldu. Hastaların 22'sinde (%64,7) eşlik eden birden çok sayıda yaralanma gözlemlendi ve bunlar en yaygın olarak dalak yaralanması (%38,2), ekstremitte kırıkları, hemotoraks (%29,4) ve karaciğer yaralanması (%26,5) şeklindeydi. Dokuz hastada (%26,5) ameliyat sonrası komplikasyonlar gözlemlendi. İzole künt travmatik rüptür mortalitesi %0 oldu. Hemorajik şok, genç yaş ve eşlik eden yaralanmalar, mortalite ve morbiditeyi anlamlı şekilde arttırdı.

SONUÇ

Diyafragmatik fitik insidansının nadir olması gerçeğine karşın, toraks ve karına ilişkin tüm künt ve penetran travmalarda diyafragma fitığından kuşulanılmalıdır. Geç komplikasyonların çoğunlukla yüksek morbidite ile birlikte olması nedeniyle, böyle bir yaralanmanın varlığı, tanısal işlemler tamamlanmadan önce ekarte edilmelidir.

Anahtar Sözcükler: Diyafragmatik herni; laparotomi; torakotomi; travma.

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RESULTS

Sennertus, in 1541, was the first to report the traumatic diaphragmatic hernia. In 1853, Bowditch recognized the injury before death and made the modern diagnosis of diaphragmatic hernia. Diaphragmatic rupture following blunt or penetrating trauma is a relatively common occurrence.^[1-3] Although the true incidence remains unknown, autopsy series of patients sustaining blunt abdominal injury suggest an incidence of approximately 5%. The injury is found more frequently in patients who sustain penetrating trauma, especially in anterior wounds below the nipple, when the occurrence may reach as high as 30%.^[1-8] In conservatively managed patients, the rate of initially missed diaphragmatic injuries ranges from 12 to 66%, and they may even be overlooked at laparotomy.^[9,10] A serious and possibly lethal complication makes a thorough and aggressive search for this injury imperative after any thoracoabdominal injury.^[11] Diagnosis of a diaphragmatic injury requires a high index of suspicion.

The aim of this retrospective study was to review the experience of our hospital with the management of traumatic diaphragmatic rupture (TDR) in order to identify predictors of outcome, associated morbidity and mortality, and factors contributing to diagnostic delay.

MATERIALS AND METHODS

The Alzahra Health Center in Esfahan is considered to be one of the busiest referral hospitals for trauma in Esfahan state. During the past three years, there were on average approximately 5000 admissions per year for blunt and penetrating trauma to the torso. The medical records of 34 patients treated for traumatic diaphragmatic hernias between August 2004 and June 2008 in Alzahra Hospital were analyzed retrospectively. We evaluated the incidence, side of TDR, mechanism of injury, associated morbidity and mortality, and predictors of outcome. The variables studied with outcome included patient age, sex, hemodynamic status upon admission, and time to diagnosis. For the purpose of statistical analysis, continuous variables were compared using the unpaired Student's t-test and differences between categorical variables were assessed using the χ^2 -test. A P-value of <0.05 was considered statistically significant.

The study identified 34 patients with TDR. The incidence of blunt and penetrating trauma to the torso was approximately 0.08%. There were 28 males (82.4%) and 6 females (17.6%) ranging in age from 1 to 68 years (mean: 32.3 years). Rupture of the diaphragm was left-sided in 22 (64.7%), right-sided in 11 (32.4%) and bilateral in 1 (2.9%) of the patients. The causes of injury were: traffic accidents (n=16, 47%), falling (n=2, 5.9%), gunshot wounds (n=4, 11.8%), stab wounds (n=8, 23.5%), and other causes of blunt trauma (n=4, 11.8%) (Table 1). Blunt trauma was the most common cause of diaphragmatic injuries (n=22, 64.7%), which were primarily due to traffic accidents. The majority of TDR following vehicular accident was left-sided in 11 of 16 patients (69%). In contrast, gunshot wounds injured the right hemidiaphragm in four of four patients (100%). In three of four patients (75%) with survivable bullet wounds, the injury was repaired using prosthetic mesh. Most of these injuries from gunshot wounds are not amenable to repair with imbrications suture because of a large defect following debridement of necrotic tissues. Stab wounds injured the left hemidiaphragm in five of eight patients (62.5%). One case of bilateral diaphragmatic rupture occurred due to stab wound. Diagnosis of TDR was recognized in less than 24 hours in 12 patients (35.3%). In the remaining 22 patients (64.7%), diagnostic delay ranged from 1 to 7 days with the exceptions of: one patient who developed left intrathoracic herniation of the colon diagnosed three years after initial injury; three patients who presented with vague abdominal symptoms one year later; and one patient who referred with the complaint of dyspnea nine months after trauma with herniation of the stomach. In the first operation, the diagnosis was recognized preoperatively in 15 patients (44.1%), and intra-operatively in 13 (38.2%). The diagnosis was missed in six (17.7%) patients in the first operation. Multiple associated injuries were observed in 22 patients (64.7%), which included spleen injury (n=13, 38.2%), fractures of the extremities and hemothorax (n=10, 29.4%), liver injury (n=9, 26.5%), rib fracture (n=8, 23.6%), pneumothorax and head injury (n=6, 17.6%), lung injury and pelvic fracture (n=4, 11.8%), strangulation of the viscera (n=3, 8.8%) and

Table 1. Causes of injuries and location of TDR

	Right hernia n (%)	Left hernia n (%)	Bilateral n (%)	Number of patients n (%)
Traffic accidents	5 (31.2%)	11 (68.8%)	0	16 (47%)
Stab wounds	2 (25%)	5 (62.5%)	1 (12.5%)	8 (23.5%)
Gunshot wounds	4 (100%)	0	0	4 (11.8%)
Falling	0	2 (100%)	0	2 (5.9%)
Other blunt trauma	0	4 (100%)	0	4 (11.8%)
Total	11 (32.4%)	22 (64.7%)	1 (2.9%)	34

Table 2. Risk factors affecting mortality in TDR

Risk factors	Non-survivors (n=5)	Survivors (n=29)	p
Age (years)	Mean: 39.6	Mean: 29.1	<0.05
Associated injuries (n)	4 (80%)	18 (62%)	<0.05
Hemorrhagic shock (n)	3 (0.6%)	7 (24.1%)	<0.05
Thoracic injuries (need thoracotomy) (n)	5 (100%)	7 (24%)	<0.05
Early diagnosis (<24 hrs) (n)	2 (40%)	10 (34.4%)	NS
Late diagnosis (>24 hrs) (n)	3 (60%)	19 (65.6%)	NS

NS: Not significant.

pericardial laceration, bowel injury, rupture of stomach, and bronchial injury (n=1, 2.9%). Hemorrhagic shock occurred in 10 patients (29.4%). Strangulation of the viscera was seen in three patients, and included the stomach in two patients, the colon in one patient and the omentum in one patient. Mean hospitalization was approximately 12.3 days. The plain chest X-rays (Fig. 1) were diagnostic in only five patients (14.7%), but were suggestive in 14 patients (41.2%) following nasogastric tube insertion. Computerized tomography (CT) scan of the chest and abdomen with intravenous and oral contrast was performed in nine patients with stable hemodynamic condition. TDR was diagnosed on the CT scan in six of the nine patients and in the others it was suggested. Surgical exploration was the method of diagnosis in the remaining patients. The diaphragm was repaired using both interrupted and running method with non-absorbable suture via laparotomy in 22 patients (64.7%), thoracotomy in seven (20.6%) and laparotomy with thoracotomy in five patients (14.7%). The method of operation depended on the clinical and radiological findings and other associated injuries. One patient presented with an acute tension feco-pneumothorax as a rarity^[12] caused by the incarceration of the

splenic flexure of the colon in the thoracic cavity after intrathoracic perforation. Postoperative complications were seen in nine patients (26.5%), and included thoracic empyema in three patients, mechanical ileus in two, pneumonia in three, and surgical site infection in two. Totally, five patients died (14.7%), one in the operating room due to irretrievable hemorrhagic shock, and the remaining four as a result of acute respiratory distress syndrome (ARDS), postoperatively. All these complications were related to associated injuries. The mortality of isolated blunt traumatic rupture was 0%. We compared age, hemodynamic status, early (<24 hrs) and late (>24 hrs) diagnosis, and associated injuries to evaluate the risk factors affecting the mortality of TDR. We found that hemorrhagic shock, young age and associated injuries (especially thoracic injuries) significantly increased and caused mortality in TDR (p<0.05). Neither early nor late diagnosis influenced the outcome of our patients significantly (p>0.05) (Table 2).

DISCUSSION

Traumatic rupture of the diaphragm resulting from blunt and penetrating trauma remains a challenging clinical entity.^[1,3,13-15] As reported, the diagnosis may

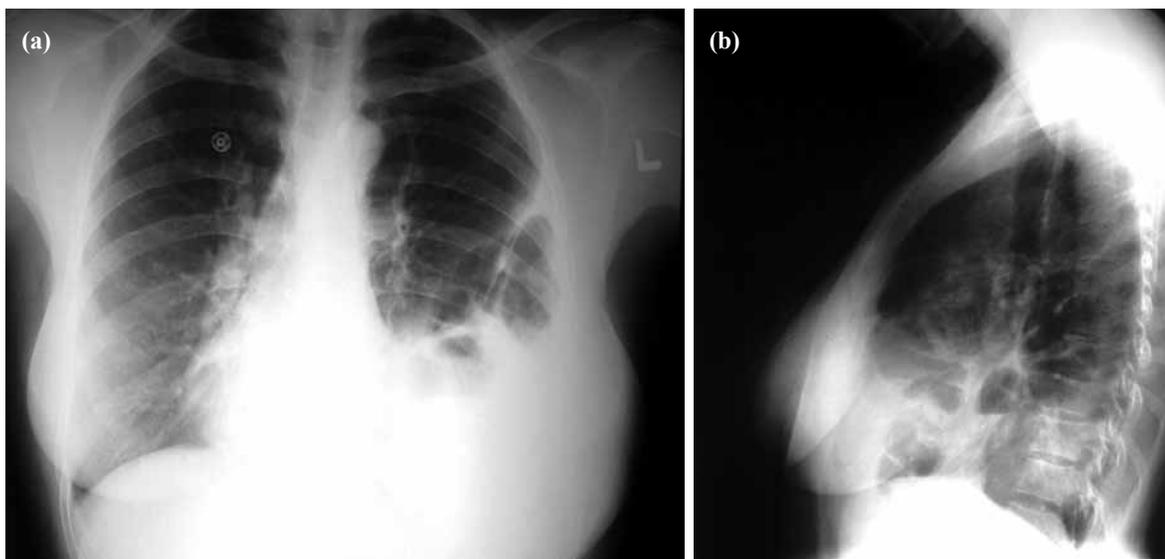


Fig. 1. Left TDR in a 38-year-old woman following a traffic accident. Chest X-ray (18 hours following the accident) shows herniation of the splenic flexure of the colon in the left hemithorax: (a) posteroanterior view and (b) lateral view.

be made clinically, as Bowditch originally described, in 30% to 50% of the cases.^[1,4] The true incidence of TDR is unknown because in 7-66% of major trauma victims, the diagnosis is missed. This is particularly true for ruptures of the right hemidiaphragm.^[2,16,17] In our study, the incidence of TDR after blunt and penetrating trauma to the torso was approximately 0.08%. The main cause of TDR was blunt trauma following traffic accident (47%). Autopsy studies suggest an equal incidence of diaphragmatic lacerations on the left and right, but clinically, left-sided lesions may be seen more because of a buffering effect of the liver on the right side. Bilateral lacerations are relatively rare and occur in 1% to 2% of patients.^[2,3] In our study, left-sided TDR occurred in 22 patients (64.7%). In addition, blunt trauma was responsible for the ruptures in 22 of 34 patients (64.7%). Bilateral diaphragmatic rupture occurred in one case (2.9%) due to stab wound. Falling was the cause of TDR in two patients (5.9%). Both patients fell from heights greater than 20 feet and had isolated transverse process fracture of the lumbar spine. Some articles suggest that transverse process fracture is a significant marker of abdominal organ injury.^[18,19] Further evaluation in forthcoming articles is needed to consider the possibility of TDR in transverse process fracture of the lumbar vertebrae in comparison to non-transverse process fracture. The mortality rates of TDR are reported as 1-28%, and were mainly due to associated injuries.^[18] In our study, mortality after isolated blunt diaphragmatic rupture was 0%, and the mortality with associated thoracoabdominal injuries was 14.7%. One study from Detroit revealed no mortality in isolated traumatic blunt diaphragmatic ruptures, which included 79 of 731 patients.^[19] It is an uncommon cause of death; associated injuries determine the prognosis. Those patients with thoracic injuries have a much greater chance of dying than patients who have other associated injuries. Blunt diaphragmatic rupture is often missed during the initial patient evaluation, and some cases are identified only with laparotomy despite negative imaging.^[20-24] The two methods most commonly used, chest X-ray and CT scan, are diagnostic in 33.3% of cases. It has been reported that CT scan and chest X-ray are diagnostic for TDR in 25-50% of blunt injuries to the chest and abdomen.^[2,4,7,25] Thus, the chest X-ray could be normal or show only slight elevation of the hemidiaphragm, especially on the right. Due to coexisting injuries and the silent nature of the diaphragmatic injuries, the diagnosis is easily missed.^[24-27] In our series, the diagnosis was missed in six (17.7%) patients in the first operation, in whom there were other associated major injuries. The first operation was performed in these missed cases with a primary diagnosis other than TDR, and the diaphragm was not observed by the surgeon. TDR is by itself an uncommon cause of

hemodynamic instability; unstable patients require immediate laparotomy. We conclude that during the operation, the surgeon must search meticulously for small and often hard-to-detect diaphragmatic injuries. A high index of suspicion and a thorough examination of both hemidiaphragms during the laparotomy are recommended in order to avoid early or late complications. The nasogastric tube may be helpful, but a forceful attempt to pass a tube should be avoided. Tube thoracostomy, for management of associated hemothorax or pneumothorax, should be carried out with care in those patients suspected of having diaphragmatic injury, to avoid further trauma to the herniated abdominal viscus. Surgical repair is the treatment of choice in all traumatic diaphragmatic hernias.

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