

Traumatic diaphragmatic ruptures in children

Çocuklarda travmatik diafragma rüptürleri

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BACKGROUND

We aimed to emphasize the importance of early diagnosis and treatment of traumatic diaphragmatic (TDR) rupture which is an uncommon but potentially life-threatening problem with a high incidence of associated injuries.

METHODS

We presented 8 children with traumatic diaphragmatic ruptures who were admitted to our department within a 13 year period after the incident. Relevant information about clinical and radiological findings herniated organs into the thorax, type of injury and applied surgical intervention and outcome of patients were evaluated so as to draw important clues leading to early diagnosis and treatment of this potentially life threatening condition with associated morbidities.

RESULTS

In five patients, TDR occurred after a blunt trauma. Five patients underwent laparotomy while 3 of them were managed with thoracotomy. The surgical interventions were performed successfully and only one patient failed to survive.. One patient died of associated severe head injury.

CONCLUSIONS

The TDR in children could be promptly identified and easily diagnosed, only if this pathology is highly suspected. Since, TDR must be ruled out in all severe cases of trauma, information related to the experiences of various centers must be considered as important clues which might lead to earlier diagnosis and prompt treatment .

Key Words: Diaphragmatic rupture, trauma.

AMAÇ

Kliniğimizde edindiğimiz deneyimlerin ışığı altında çocuklarda seyrek rastlanılan, ancak potansiyel olarak yaşam tehlikesi yaratan ve ek yaralanmaların da eşlik ettiği ciddi bir klinik sorun olan travmatik diafragma rüptürlerinin (TDR) erken tanı ve tedavisine ilişkin önemli ipuçlarını ortaya koymak

GEREÇ VE YÖNTEM

On üç yıllık bir dönem içinde travmatik diafragma rüptürüyle (TDR) ile bölümümüzde tedavi ettiğimiz 8 olguyu sunuyoruz. Hastaların yaralanma tipi, klinik ve radyolojik bulguları yaralanmanın yeri, toraksa fıtıklaşan organlar, yapılan cerrahi girişimler ve hastaların sonuçlarına ilişkin bilgiler rapor edilmiş ve hastalar potansiyel olarak yaşam tehlikesi yaratan ve ek yaralanmaların da eşlik ettiği ciddi bir klinik sorun olan travmatik diafragma rüptürlerinin erken tanı ve tedavisine yönelik ipuçları açısından değerlendirilmiştir..

BULGULAR

Beş olguda, künt travma sonucu travmatik diafragma rüptürü oluşmuştur.. Beş hasta laparotomi ile tedavi edilirken, 3 olguda torakotomi uygulandı. Bir hasta dışında tüm olgularda tedavi başarılı olurken, bir hastamız eşlik eden ciddi kafa travması nedeniyle kaybedildi.

SONUÇ

Ancak travmatik diafragma rüptüründen çok kuşulanıldığı takdirde çocuklarda bu patoloji hemen tanınabilirdi ve bu durumda tanı koymak oldukça kolaylaşabilir. Ciddi travma olgularının tümünde travmatik diafragma rüptürünün dışlanması gerektiğinden çeşitli merkezlerin deneyimlerine ilişkin bilgiler bu çocuklarda erken tanı ve hızlı tedaviye yönelik önemli ipuçları sunabilir.

Anahtar Sözcükler: Diafragma rüptürü, travma

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INTRODUCTION

Traumatic diaphragmatic rupture (TDR) is an uncommon but well recognized complication of trauma that consists of 1- 5.8% of admissions into a trauma unit^[1] The difficulty of the diagnosis and high morbidity and mortality rates are associated with untreated cases make this clinical entity more important^[2] When diaphragmatic injuries cannot be recognized in the acute phase of the trauma, the affected structures may be strangulated into the thorax and therefore the mortality rate may increase from 20 up to 80%.^[3]

The purpose of this report is to review our experience with TDR in our department and to identify the clinical findings and diagnostic modalities which might offer important clues to earlier diagnosis and prompt therapy in childhood.

MATERIALS AND METHODS

Between 1988 and 2001, all children with TDR admitted to our department were enrolled into the study. The ages, gender, duration between trauma and the hospital admission, type of the injury, clinical/radiological findings, relevant information pertaining to the affected side, herniated organs into the

thorax, associated injuries, type of the surgery, hospital stay, outcomes of the patients were recorded.

RESULTS

Within a 13-year period, eight patients were treated for TDR in our department (Table I). There were 5 boys and 3 girls whose ages ranged from 2 years to 15 years (mean 9.7 years). TDR occurred following blunt trauma in 5 and penetrating trauma in 3 cases. Four ruptures occurred on the left and 1 on the right side in the blunt trauma group. In the penetrating trauma group, 2 ruptures occurred on the right and 1 on the left side. The majority of the ruptures were localized centrally in both groups.

Five patients were admitted to our hospital in a few hours following the trauma and the others on the 2, 10, and 17, days after injury. One of these patients had undergone an emergent operation a trauma center initially but no diaphragmatic rupture was recognized in. One patient was sent to our hospital with the complaint of gastric fluid drainage from the thoracic drainage tube. The tube had been inserted into the herniated stomach which was mistaken as a pneumothorax. One of the late admitted cases was sent to our hospital at the second day after the traffic accident with a moderate respiratory distress.

Table 1: Characteristics of the patients

CASE NUMBER	GENDER	AGE	TIME TO ADMISSION	TYPE OF TRAUMA	AFFECTED SIDE	TYPE OF HERNIATION	PREVIOUS SURGERY	HOSPITAL STAY
1	girl	15	17. day	blunt	left posterolateral	-	abdominal	9 days
2	boy	2	2. day	blunt	left lateral and medial	stomach, liver +	abdominal	6 days
3	boy	9	10. day	blunt	left central	stomach +	thoracal	30 days
4	boy	8	in hours	blunt	right central	liver +	abdominal	15 days
5	girl	10	in hours	penetrating	left lateral	-	thoracal	10 days
6	boy	11	in hours	penetrating	right central	-	abdominal	11 days
7	boy	13	in hours	penetrating	right lateral	-	thoracal	14 days
8	girl	12	in hours	blunt	Left central	stomach	abdominal	6 weeks

Table 2: The clinical and radiological findings of the TDR patients.

History	Physical Examination	Radiological Findings
Abdominal pain (7)	Decreased breath sounds (7)	Abnormal diaphragm (7)
Dyspnea (6)	Abnormal thoracic percussion (5)	Pleural effusion (4)
Vomiting (4)	Acute abdomen (5)	Rip fracture (4)
Chest pain (4)		Mediastinal shift (3)
Pericostal trauma (4)	Bowel sounds in thorax (3)	Abdominal viscera in chest (3)

The clinical and radiological findings of the patients are detailed in Table 2. Abdominal pain and the dyspnea were the most common symptoms of the patients. In 3 patients bowel sounds were auscultated in the thorax which were considered pathognomonic for diaphragmatic herniation. The predominating finding during the physical examination was mild abdominal tenderness.

We found abnormalities in all chest X-rays. Elevated or indistinct diaphragm and pleural effusion were the most common radiological findings. Abdominal viscera were found within the thoracic cavity in 3 patients who were from blunt trauma group (Figure 1). The stomach and the liver were found to be organs herniated. TDR was diagnosed in one patient during an upper gastro-intestinal (GI) radiological study using barium sulfate. Computerised tomography (CT) was performed in 3 patients but it was diagnostic only in one of them. In one patient we also performed diagnostic laparoscopy and the thoracoscopy. TDR was diagnosed intraoperatively in a patient. Medical history, physical examination and properly selected radiological studies provided the correct preoperative diagnosis in 6 out of 8 patients.

TDR usually occurs together with multiple associated injuries. In this series only one patient had isolated diaphragmatic injury. Associated injuries are shown in Table 3. In our study, chest and abdomen were the most commonly affected sites for associated injuries. In abdomen, the liver and the spleen were the organs affected mostly. Retroperitoneal hematoma was also observed equally.

Five patients underwent laparotomy. In the laparotomy group 4 patients had blunt and one patient had a history of penetrating trauma. In case 5, we performed a laparoscopy initially which was failed to be diagnostic and accordingly thoracoscopy

was performed for the establishment of precise diagnosis. The repair of this case was carried out through a thoracotomy incision. Thoracotomy was also performed in the remaining 2 patients. Primary repair of all the diaphragmatic defect was accomplished using monofilament nonabsorbable sutures in two layers.

Postoperative early complication was empyema which was developed in one patient in the penetrating trauma group. As a late complication, intraperitoneal adhesions due to intestinal obstruction was observed in one patient at the third month following the trauma. One of our female patients who had a major head injury, had undergone decompression surgery, and remained in the intensive care unit for 6 weeks. Although her postoperative course after diaphragmatic surgery was uneventful, and she died of severe head trauma.

DISCUSSION

Either thoracic or abdominal trauma might lead to rupture of the diaphragm. Early diagnosis of TDR is sometimes difficult because of the high incidence



Figure 1: Chest X-ray of a patient with left sided TDR prior to surgery.

of associated injuries. Musculoskeletal system and abdominal injuries are the most common sites of associated injuries and the incidence of associated injuries is as high as 90%.^[4] In the literature blunt traumatic rupture has been demonstratedly associated with an average of 3.2 traumatic events per patient.^[5] In this study, 2.6 injuries traumatic events per patient were observed and the most of the associated injuries were located in the chest and the abdomen. One of our patients however had a very severe fatal head injury.

The dome of the left side of the diaphragm which is the commonest side of rupture in adults, is devoid of the protection of viscera from the compressing forces transmitted from the blunt trauma and distributed equally throughout the abdomen. Brown et al.^[4] attributed the higher incidence of phrenal ruptures in childhood to the shearing force of the thoracic compression causing distortion of the hoop on which the diaphragm is hanged. In our cases with blunt trauma, although the left central rupture was seen predominantly in adults, the mean age of our patients was higher (9.7 years) compared with the Brown's group (4.5 years).^[4]

Regardless of the mechanism of the injury, the early recognition of an occult TDR usually depends on a high index of suspicion. A combination of any of the following factors should arise suspicion of TDR and prompt further diagnostic investigation: Pericostal injury, fracture of pelvis or lumbar spine reflecting a major compression of the torso, dyspnea, pain in the lower chest or upper abdomen, dullness or tympany over the lower chest, mediastinal shift and bowel sounds in the chest should arise suspicion.^[3,6] In our group, at least three of these findings per patient were apparent.

It has been reported that approximately 85% of the patients with a TDR have abnormal findings on

chest X-rays, however only one third of these radiograms have shown pathognomonic evidence of diaphragmatic rupture.^[7,8,9] Findings including loss of normal contour of the diaphragm and gas bubbles, air fluid levels or other unusual shadows above the diaphragm strongly suggestive of diaphragmatic rupture were reported even in 58% of the patients.^[10] The occurrence rates of diagnostic findings in our group was 62% complying with the findings reported in the literature.

When the clinical and chest X-ray findings suggest a diaphragmatic injury, appropriate contrast GI studies may be helpful conclusive diagnostic tools for the precise diagnosis. We performed an upper GI study in one patient to reach a definitive diagnosis. Although ultrasound is a noninvasive modality, a conclusive diagnosis may be difficult particularly in the patients without herniation.^[11] CT is a reliable diagnostic tool in cases with suspected diaphragmatic injury long after the traumatic event.^[12,13] We used CT only in 3 of our cases and it was suggestive for TDR in two of them.

Although the use of laparoscopy in abdominal trauma has been proposed for several decades, it has not been widely used. To avoid unnecessary laparotomies in cases without peritoneal penetration, laparoscopy is a beneficial diagnostic method.^[14,15] Laparoscopy in trauma appears to be best suited for detecting injuries in the intrathoracic abdomen and the use of laparoscopy in trauma has been previously reserved for blunt injuries.^[5]

Thoracoscopy allows evaluation of diaphragm in penetrating trauma without traumatising the abdomen and may be the only minimally invasive access to evaluate the diaphragm prior to abdominal surgery.^[16] Thoracoscopy and/or laparoscopy may be useful diagnostic tool(s) for confirming the presence of a occult diaphragmatic rupture after a severe

Table 3: Associated injuries of the TDR patients.

Chest n: 8	Abdomen n: 8	Musculoskeletal n: 5	Head n: 3
Pneumothorax (4) Hemothorax.(3) Bronchopleural-fistula(1)	Liver (2) Spleen (2) Retroperitoneal hematoma(2) Intestine(1) Evisceration (1)	Rip fracture(4) Pelvic Fracture (1)	Closed head injury (3)

blunt injury.^[17] We performed laparoscopy and thoracoscopy in one patient. Although a diaphragmatic rupture was detected, it could not be treated using thoracoscopic interventions. Therefore, we performed thoracotomy for the this patient.

As the majority of patients with acute rupture have more than one intraabdominal injury, the surgical repair of the defect is the preferred method of treatment. Cases with left sided lesions can be promptly repaired by the abdominal approach. We used abdominal approach in 3 of 5 cases of left sided lesions. In one patient we preferred the thoracic approach because of the delayed diagnosis of this patient. Thoracic approach is recommended by Payne and Yellin for the patients with right sided ruptures and also with latent diaphragmatic hernias^[3] In one of the patients with right sided TDR, we performed a thoracotomy and in another patient with right sided TDR, laparotomy was performed due to multiple associated abdominal injuries.

All but one patient survived after operative repair of TDR, and the postoperative courses of the survivors were free of complications. One patient had an associated severe head trauma. She underwent decompressive surgery for head injury and intensive life support was provided. Nevertheless, she could not survive, although her repair of TDR was successful and free of any complication. Our rate of mortality (11,1%) is lower than most of the pediatric series in the literature.^[18]

It is no doubt that in recent years, a greater number of severely injured patients are reaching trauma centers earlier. Meanwhile the trend of conservative management of trauma patient is increasing with better monitoring facilities. TDR is a rare injury, however it must be suspected in all pediatric trauma patients. The prompt identification of TDR depends on a high index of suspicion and careful attention to physical and chest X-ray findings initially. If high index of suspicion suspicion is attained, the diagnosis is not very difficult. Chest / abdominal X-ray and in particular cases, CT and USG improve the accuracy of diagnosis. With early diagnosis and prompt therapy, morbidity and mortality rates will be lower in children with TDR.

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