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Rare Presentations and Repair of Delayed Traumatic Diaphragmatic Rupture: Report of 39 Cases Over 10 Years

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Abstract

Background: Diaphragmatic rupture is a life threatening condition, which may be due to severe penetrating or blunt trauma to the chest or abdomen. Considering that delayed diaphragmatic rupture has no clinical symptoms, results of diagnostic methods are restricted to the case report studies, also lack of early diagnosis of it in patients with multiple trauma and diversity of therapeutic methods, we decided to investigate the etiology, clinical symptoms, diagnostic and therapeutic methods of patients with delayed diaphragmatic rupture.

Methods: In this retrospective study, we reviewed the data of all patients with diagnosis of delayed traumatic diaphragmatic rupture in surgical wards of Razi, Poursina and Aria hospitals of Rasht, Iran, between March 2006 and September 2016. Demographic and clinical data of patients were recorded. Finally, normality of the variables distribution was tested by using the one sample Kolmogorov-Smirnov test.

Results: Patientsincluded in this study, 24 (61.5%) male and 15 (38.4%) female. The age of patientswas 10 to78 years old and the mean age was 38.84±18.54 years. Traffic crashes were the most common cause of traumatic diaphragmatic rupture in our study (41.0 %). Dyspnea was the most common symptom in our subjects (79.4%); Intestinal obstruction in 5 patients and Tension gasterothorax in 4 patients. 84.6% of our patients had right sided traumatic diaphragmatic rupture. The mean size of rupture in our subjects was 11.16±4.52 centimeters. Omentum was the most herniated organ (31.1%). Chest x-ray and computed tomography scan were used in all of our subjects for diagnosis of diaphragmatic rupture. The mean duration between trauma and surgery was 70.39±99.38 months. The mean duration of hospitalization was 7.92±5.05 days. The most common surgical method which was used for treatment of delayed diaphragmatic rupture in our patients was thoracotomy (74.3%). In the recent study, primary treatment of diaphragm was performed in 32 patients, partial mesh in 5 and complete mesh in 2 of patients.3 (5.2%) of our subjects died.

Conclusion: Diagnosis of diaphragmatic rupture is difficult and has a clinical suspicion in high risk patients. So using of radiological modalities for diagnosis and treatment of it is necessary. Moreover, delayed diaphragmatic rupture and diaphragmatic hernia should be considered in patients with recent blunt trauma and gastrointestinal or respiratory complaints.

Keywords: Diaphragmatic rupture; Hernia; Traumatic; Mesh

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Background

Diaphragm is a domical muscular structure, which is composed of right and left hemidiaphragm. This muscle is different with other muscles of body in terms of structure and function. It divides thorax from the abdominal cavity and is one of the major breathing muscles [1]. Diaphragmatic rupture is a life threatening condition, which may be due to severe penetrating or blunt trauma to the chest or abdomen [2]. Traffic crashes and falling down from height are the most common causes of diaphragmatic rupture. Moreover, spontaneous diaphragmatic rupture has been reported [3-6]. The prevalence of blunt traumatic diaphragmatic rupture is reported between 0.8 and 5%, which may increases up to 30% with delay [7]. Because of accompanying injuries, silent nature and non-specificity of symptoms, diaphragmatic rapture usually finds in acute phase during exploratory laparotomy and even may not be found. Diaphragmatic rupture in 70% to 90% of cases is left-sided.

Figure 1: CXR: tension colothorax with obstruction.

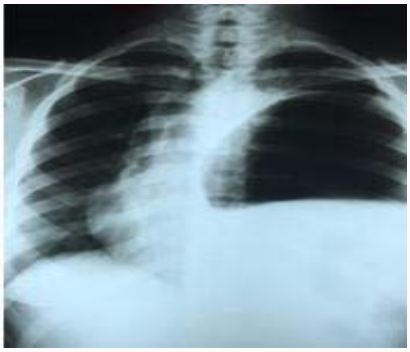

Figure 2: CXR: tension gasterothorax.

Figure 3: CT-scan: tension gastero-colothorax.

Figure 4: Tension hepatothorax.

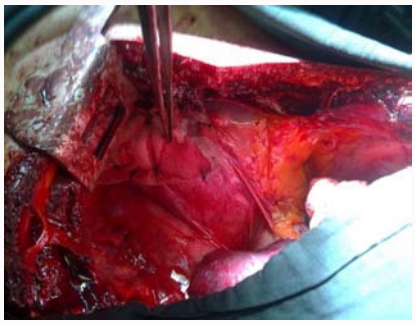

Figure 5: Partial mesh repair.

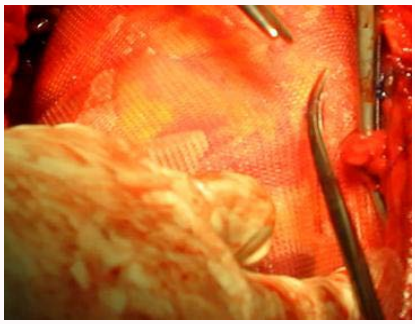

Figure 6: Complete mesh repair.

About 50% of patients with diaphragmatic rupture had no symptoms and present with complications of damage during years after the initial trauma. Delay in diagnosis of diaphragmatic rupture varies between few days and 50 years. Undiagnosed patients with diaphragmatic injury may present with a wide range of complaints from abdominal discomfort to diaphragmatic rupture and secondary herniation, which may cause respiratory symptoms and gastrointestinal obstruction due to incarceration of herniated organs [2,4,8,9]. The prevalence of death in secondary traumatic diaphragmatic hernia with incarceration is reported 20% and with strangulation is 40%-57% [10]. Diagnosis of diaphragmatic rupture is difficult. So that 12% to 69% of injuries were not diagnosed before operation. Although chest x-ray (CXR) is primary diagnostic evaluation but the sensitivity of it in left-sided diaphragmatic rupture is 46% and in right-sided is 17% (Figure 1 and 2). Computed tomography (CT) scan is the first choice of imaging modalities in severe blunt abdominal trauma (Figure 3 and 4). Thoracoscopy, laparascopy, Magnetic Resonance Imaging (MRI), ultrasound or fluoroscopic evaluations of diaphragmatic movements are others proposed diagnostic methods in diaphragmatic rupture [2,6,7]. Treatment of traumatic diaphragmatic rupture can be performed by thoracotomy or laparotomy. But in delayed traumatic rupture, thoracotomy is the first choice, because of adhesions between herniated organs and lung. Moreover, thoracoscopic and laparoscopic surgery in cases without damage of intraabdominal organs and treatment of mesh in cases with large damages of diaphragm were proposed [4]. Considering that delayed diaphragmatic rupture has no clinical symptoms, results of diagnostic methods are restricted to the case report studies and also lack of early diagnosis of it in patients with multiple trauma and diversity of therapeutic methods, we decided to investigate the etiology, clinical symptoms, diagnostic and therapeutic methods of patients with delayed diaphragmatic rupture.

Methods

In this retrospective study, we reviewed the data of all patients with diagnosis of delayed traumatic diaphragmatic rupture in surgical wards of Razi, Poursina and Aria hospitals of Rasht, Iran, between March 2006 and September 2016.The data of patients including age, sex, the cause of damage, primary symptoms, results of imaging, duration between trauma and surgery, side, location and size of diaphragmatic rupture, treatment, herniation of viscera

Table 1: Clinical characteristics of patients.

		N=39
Symptoms and signs		
	Dyspnea	31
	Abdominal pain	29
	Chest pain	10
	Nausea	8
	Obstipation	5
	Tension gastrothorax	1
	Nocturnal snoring	1
Cause of damage		
	Traffic crashes	16
	Undetermined	8
	Penetrating trauma	6
	Blunt trauma	5
	Falling down from height	3
	Iatrogenic	1
Location of damage		
	Left	33
	Right	6
	Bilateral	0
Size of damage (centimeter)		
	<10	15
	10-15	12
	>15	12
Herniated organs		
	Omentum	34
	Colon	29
	Stomach	22
	Spleen	10
	Small intestine	6
	Liver	6
	Kidney	2
Diagnostic tool		
	Chest x-ray	39
	Computed tomography scan	39
	Abdominal x-ray	16
	Laparatomy	5
	Magnetic resonance imaging	1
	Barium enema	1
Duration between trauma and diagnosis (year)		
	<1	15
	1-5	7
	5-10	4
	>10	6
Duration of hospitalization (days)		
	<5	15
	5-10	19
	10-15	1
	15-20	1
	20-25	2
Therapeutic method		
	Thoracotomy	29
	Laparotomy	5
	Thoracotomy+laparotomy	5
Complication of damage		
	Herniation	37
	Strangulation	8
	Incarceration	8
	Hemothorax	5

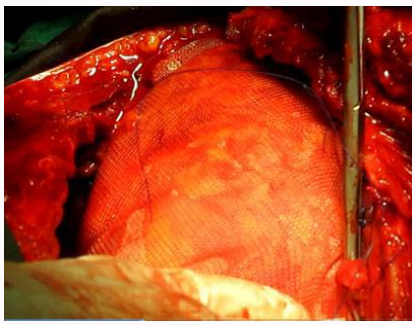

Figure 7: Total reconstruction of diaphragm with prolen mesh (33x33).

and strangulation of them, repair with Mesh(Figure 5 and 6), need for mechanical ventilation and duration of it, duration of stay in the intensive care unit (ICU),hospital stay, complications, result of treatment,mortality and the cause of death were recorded.

Statistical analysis

Results were expressed as mean±standard deviation or as number (percentage). Normality of the variables distribution was tested by using the one sample Kolmogorov-Smirnov test. All statistical analyses were done by the program SPSS 22 for Windows.

Results

Patients included in this study, 24 (61.5%) male and 15 (38.4%) female, age of patient were 10-78 years old and the mean age was 38.84±18.54 years.Clinical characteristics of patients with delayed traumatic diaphragmatic rupture were listed and summarized in Table 1. The causes of delayed diagnosis in our study were: A Lack of good surveillance during surgery by surgeon B. Lack of diagnosis by radiologist C. Lack of good follow up after discharge from the hospital D. Lack of attention to the symptoms by patient E. Lack of attention to the symptoms and signs of patients by physicians F. Lack of consent to surgery by patients.Primary repair of diaphragm was performed in 32 patients, partial mesh in 5 and complete mesh in 2 patients (Figure 5 and 6). Postoperative complications in our patients were wound infection in 5, empyema in 2, and air leakage in 3, atelectasis in 4 and pneumonia in 4 cases. These complications were seen in patients with strangulations and incarcerations of intestine and stomach. Three (5.2%) of our patients died. The causeof death in one patient was multi organ failure, in another patient was old age, and delayed diagnosis, sepsis and multi organ failure. Moreover, one patient that was a 16 year girl died, because of delayed diagnosis and

Figure 8: Tension gasterothorax in 16 years old girl.

tension gastrothorax (Figure 2 and 8).

Discussion

In the present study, the mean age of patients was 38.84±18.54 years old that was approximately similar to Pourzand and Bergeron studies (36.6 and 40.1±16.2 years, respectively) [5,16]. In our study, there was more than one symptom in most of patients and dyspnea was the most common symptom in our subjects. While in Mohi-Aldeen study, the most common symptom was abdominal pain [15]. Traffic crashes were the most common cause of traumatic diaphragmatic rupture in our study (41.0 %), similar to Kuo study [13]. An 84.6% of our patients had left sided traumatic diaphragmatic rupture and bilateral traumatic rupture was observed in any of our subjects. These findings were approximately similar to previous studies [4,12,15]. The mean size of rupture in our subjects was 11.16±4.52 centimeters (cm) (between 4 cm and 20 cm) while in Yalcinkaya study the size of rupture was between 0.5 cm and 15 cm [12]. In Matsevych study, the size of lesions in patients with acute diaphragmatic rupture was more than 10 cm and in patients with post traumatic diaphragmatic rupture was between 2 cm and 5 cm [14]. Out of our patients, visceral hernia was observed in 35 subjects and 5 of them had strangulation. In most of our cases, more than one organ had herniation so that omentum was the most herniated organ. This result was similar to Haciibrahimoglu study [11] while in Mohi-Aldeen study, the most herniated organ was stomach [15]. Tension gasterothorax rarely reported in literature but in our study we have rare presentation of this case [17,18] CXR and CT scan were used in all of our subjects for diagnosis of diaphragmatic rupture. Moreover, MRI in 1, barium enema in 1, laparotomy in 5, abdominal x-ray in 16 cases was used for diagnosis of damages. In Mala study CXR in all of subjects, CT scan and laparotomy in half of cases were used as diagnostic tools [4]. In the recent study, except 8 patients with unknown etiology of diaphragmatic rupture, the mean duration between trauma and surgery was 70.39±99.38 months. In Mala study, the diaphragmatic rupture was diagnosed in 7%-16% of cases during 12 hours, 33.3% during 24 hours and 50% during more than 6 months [4]. Moreover, in Pourzand study, 5% of cases were diagnosed as delayed diaphragmatic rupture during 24 hours to 8 months after trauma [5]. None of our patients was admitted in ICU and none of them needed for mechanical ventilation. The mean duration of hospitalization was 7.92±5.05 days (between 3 and 25 days) in our subjects. In Pourzand study, the mean ICU length of stay was 2.08 and the mean duration of hospitalization was 8 days [5]. The most common surgical method which was used for treatment of delayed diaphragmatic rupture in our patients was thoracotomy (29 subjects). In the recent study, primary repair of diaphragm was performed in 32 patients, partial mesh in 5 and complete mesh in 2 of our patients (Figure 5 and 6). With of our knowledge we didn't find total distraction of right diaphragm.But in two of our cases we fixed prolen mesh (33x33) with non-absorbable suture to the rib around the pleural cavity (Figure 7 and 8). In Yalcinkaya study, the most common therapeutic approaches were thoracotomy, laparotomy, thoracotomy + laparotomy in 57.6%, 27% and 15.4% of subjects, respectively and in all cases primary treatment of diaphragm was performed [12]. In Matsevych study diaphragmatic rupture in all patients was treated by laparotomy and only one patient with delayed diaphragmatic rupture needed to thoracotomy [16]. Two (5.1%) of our patients had no complications but in most of cases there were more than one complication so that herniation with prevalence of 94.8% was the most common complication of our subjects. Also in Yalcinkaya study, 46% of subjects had herniation as complication of diaphragmatic rupture [12]. Three (12.2%) of our subjects died. Out of these, a 16-year-old girl was admitted with tension gastrothorax, which is a rare presentation of delayed traumatic diaphragmatic rupture. This patient expired after transthoracic needle decompress of stomach with Re-expansion pulmonary edema [19]. Report of such case in previous articles is very rare and there is little information about the treatment of it. In Mohi-Aldeen study, three (7.8%) of patients died and the cause of death in all of them was irreversible shock [15] while in Pourzand study none of patients with delayed diaphragmatic rupture died [5].

Conclusion

Diagnosis of diaphragmatic rupture is difficult and has a clinical suspicion in high risk patients.So using of radiologic modalities for diagnosis and treatment of it is necessary. Moreover, delayed diaphragmatic rupture and diaphragmatic hernia should be considered in patients with recent blunt trauma and gastrointestinal or respiratory complaints. We warranted further studies to evaluate the post-operative quality of life of patients with delayed diaphragmatic rupture and the rate of recurrence of diaphragmatic rupture in these patients.

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