

*Research Article***Management of diaphragmatic injury after blunt trauma in children****Khaled Mohamed M. Shahin, Yasser Ali Kamal**

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Abstract

Objective: To describe and evaluate our experience with traumatic diaphragmatic injury (TDI) after blunt trauma. **Patients and Methods:** The children had TDI after blunt trauma at the emergency department of our institution between 2010 and 2016, were reported with description of their clinical characteristics and management. **Results:** The study included 16 children (12 boys and 4 girls), with mean age of 7.93 ± 3.45 years. The most frequent mechanism of injury was motor car accident (62.5%), and the left hemi-diaphragm was the most common location of injury (68.75%). Chest radiographs was the initial imaging study in all patients, while chest CT was used also in 75% of them. The surgical approach was laparotomy in most of the patients (68.75%). Primary suture of the diaphragm and tube thoracostomy were performed in all patients. There was no mortality in this study. The reported postoperative complications were atelectasis (25%), pneumonia (12.5%) and empyema (6.25%). The occurrence of postoperative complications (if any) correlated significantly with delayed diagnosis (> 48 hours), presence of associated abdominal injury, and hemodynamic instability at admission. **Conclusion:** Early detection and intervention for blunt TDI in children can reduce the morbidity after surgery.

Keywords: Trauma, diaphragm, children**Introduction**

Occurrence of traumatic diaphragmatic injury (TDI) indicates its association with serious injury and severe trauma. There are multiple studies describing TDI in adult patients, however, there is little investigation of the pediatric injuries. In children, TDI is a rare entity due to the elasticity of their tissues, with a high possibility of delayed diagnosis. Thus, TDI remains a challenging clinical problem in children^[1].

The cause of TDI may be blunt or penetrating thoraco-abdominal trauma. The blunt TDI in children is more difficult to assess than in adults for anatomical and physiological reasons. Because of the compliance of the chest wall in children, an internal injury may occur after blunt trauma in the absence of the external evidence^[2]. This study aimed to evaluate our own experience with blunt TDI in children in

regard to clinical presentation, diagnostic workup, and outcome after surgical treatment.

Patients and Methods

This retrospective study included children (<18 years old) admitted to the emergency department of Minia University Hospital with diaphragmatic injury following blunt thoraco-abdominal trauma, between 2010 and 2016. The data was obtained from the records of the patients.

The collected information included demographic data regarding age and gender, as well as clinical data regarding mechanism of trauma, hemodynamic instability at admission, associated injuries, time to diagnosis, surgical approach, presence of diaphragmatic hernia, postoperative complications, and the length of ICU and hospital stay.

Statistical analysis was performed using the SPSS software package (version 16.0; SPSS Inc, Chicago, IL, USA). The data were expressed as mean \pm standard deviation for quantitative variables, or as proportions for qualitative variables. Non-parametric Spearman's rho test was used for bivariate correlation of the clinical variables with the presence of any postoperative complication. P-value < 0.05 was considered statistically significant.

Results

As shown in table 1, the study included 16 children (12 boys and 4 girls), with mean age of 7.93 ± 3.45 years. The most frequent mechanism of injury was motor car accident (62.5%), followed by fall (18.75%), motorcycle collisions (12.5%), and crush (6.25%). The left hemi-diaphragm was the most common location of injury (68.75%), followed by right (25%), and bilateral location (6.25%). The time to diagnosis was < 48 hours in 75% of the patients, while delayed presentation > 48 hours was reported in the remaining 25%. Chest radiographs was the initial imaging study in all patients, while chest CT was used also in 75% of patients.

The blunt TDI leads to diaphragmatic hernia in 18.75% of children. The associated thoracic

injuries included hemopneumo thorax in 68.75%, rib fracture in 50%, pulmonary contusion in 43.75%, and lung lacerations in 12.5%. The associated abdominal injuries included injury of spleen (37.5%), small bowel (12.5%), and liver (6.25%). Other associated injuries included orthopedic injuries (18.75%). The hemodynamic instability at admission was found in 31.25% of patients. One case (6.25%) was diagnosed intra-operatively during laparotomy for traumatic intestinal injury.

The surgical approach was laparotomy in most of the patients (68.75%), followed by thoracotomy (18.75%), and thoraco-abdominal incisions (12.25%). Primary suture of the diaphragm and tube thoracostomy were performed in all patients. There was no mortality in this study. The reported post-operative complications were atelectasis (25%), pneumonia (12.5%), and empyema (6.25%). The mean length of ICU stay was 4.56 ± 2 days and the mean length of hospital stay was 10.25 ± 5.42 days. As shown in table 2, the occurrence of postoperative complications (if any) correlated significantly with delayed diagnosis > 48 hours (r-value = 0.74, p-value = 0.001), presence of associated abdominal injury (r-value = 0.51, p-value= 0.04), and hemodynamic instability at admission (r-value = 0.59, p-value = 0.01).

Tables

Table (1): Clinical profile and surgical outcome

Variables	Patients (n=16)
Age (years), mean \pm SD	7.93 \pm 3.45
Gender, n (%):	
Boys	12 (75%)
Girls	4 (25%)
Mechanism of injury, n (%):	
Motor car accident	10 (62.5%)
Fall	3 (18.75%)
Motorcycle	2 (12.5%)
Crush	1 (6.25%)
Location, n (%):	
Left	11 (68.75%)
Right	4 (25%)
Bilateral	1 (6.25%)
Time to diagnosis, n (%):	
<48 hours	12 (75%)
>48 hours	4 (25%)
Imaging study, n (%):	
Chest radiographs	16 (100%)
Chest CT	12 (75%)
Diaphragmatic hernia, n (%):	3 (18.75%)
Associated thoracic injuries, n (%):	
Hemopneumothorax	11 (68.75%)
Rib fracture	8 (50%)
Pulmonary contusion	7 (43.75%)
Lung lacerations	2 (12.5%)
Associated abdominal injuries, n (%):	
Spleen	6 (37.5%)
Small bowel	2 (12.5%)
Liver	1 (6.25%)
Other associated injuries, n (%):	
Orthopedic	3 (18.75%)
Hemodynamic instability, n (%):	5 (31.25%)
Surgical approach, n (%):	
Laparotomy	11 (68.75%)
Thoracotomy	3 (18.75%)
Thoracotomy plus laparotomy	2 (12.50%)
Postoperative complications, n (%):	
Atelectasis	4 (25%)
Pneumonia	2 (12.5%)
Empyema	1 (6.25%)
Length of ICU stay (days), mean \pm SD:	4.56 \pm 2
Length of hospital stay (days), mean \pm SD:	10.25 \pm 5.42

Table (2): Bivariate correlation of the clinical variables with the presence of any postoperative complication (Non-parametric Spearman's rho test)

Variables	r-value	p-value
Age	0.19	0.46
Gender: female	-0.14	0.58
Mechanism: motor car accident	-0.20	0.45
Location: left	0.24	0.36
Time to diagnosis: > 48 h	0.74	0.001*
Diaphragmatic hernia	0.28	0.27
Associated lesions: thoracic	-0.03	0.89
Associated lesions: abdominal	0.51	0.04*
Associated lesions: others	0.14	0.58
Hemodynamic instability	0.59	0.01*
Surgical approach: thoracotomy	0.31	0.23

r-value: correlation coefficient.*Significant correlation

Discussion

The main finding of this study is the correlation of delayed diagnosis (>48 hours), presence of abdominal injuries, and hemodynamic instability at presentation, with unfavorable outcome (atelectasis, pneumonia, or empyema) after surgery for blunt TDI in children. This finding is explained by increased risk of obstruction and strangulation in the affected structures when TDI cannot be recognized in the acute phase with subsequent sepsis and high rate of morbidity and mortality^[3].

The male predominance in our children with blunt TDI may be attributed to boys playing outdoors unattended more than girls do. Left diaphragmatic injury was more frequent following trauma owing to the weaker structure of that side. The right hemi-diaphragm is congenitally stronger than the left side, and the liver serves as extra protection and support^[4].

The diagnosis was made mainly on a high index of suspicion, with one case (6.25%) diagnosed during laparotomy and delayed diagnosis (>48 hours) in 25% of patients. The clinical findings which may raise the suspicion for TDI and the need for further diagnostic investigation include pericostal injury, fracture of pelvis or lumbar spine, dyspnea, pain in the lower chest or upper abdomen, dullness or tympany over the lower chest, mediastinal shift and bowel sounds in the chest^[5]. Computed tomography was needed in addition to chest radiographs as an ancillary diagnostic tool in 75% of cases in suspect cases. Thoraco-abdominal CT is helpful in the

detection of associated injuries and for planning the surgical approach^[6]. There was no mortality in our children with blunt TDI, which may be attributed to absence of associated severe head or spinal injuries, in consistence with other studies^[6,7].

Laparotomy was the most commonly used approach for the management of blunt TDI (68.75%), followed by thoracotomy (18.75%) and thoracotomy plus laparotomy (12.25%). The surgical approach for TDI depends on the location, size, hemodynamic stability, and associated injuries. The abdominal approach should be the procedure of choice particularly for patients with severe trauma to provide better exposure^[8].

In conclusion, blunt TDI in children is unusual type of trauma when compared to that in adults as it can occur in the absence of severe injuries and needs early detection and intervention to reduce unfavorable outcomes of delayed diagnosis.

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