

Epidemiological analysis of pediatric patients with thoracoabdominal trauma in the emergency department

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SUMMARY


Objective: The study aimed to evaluate the causes of trauma, diagnostic treatment methods, and the results in the patients who were admitted to the emergency department with pediatric thoracic and abdominal trauma.


Method: In this study, between January 2014 and December 2018, 959 patients under 18 years of age who were admitted to the emergency department due to the thorax and abdominal trauma were included. Of these, 557 (58.1%) were male, with a mean age of 9.3 years (range, 1-16 years). Demographic characteristics, trauma patterns, and mortality results of these patients were evaluated retrospectively.

Results: 933 (97.3%) of the cases were blunt, and 2 (2.7%) were penetrating traumas. Of the trauma cases, 436 (4.5%) fell from lower than one meter, 323 (33.7%) fell from higher than one meter, 174 (18.1%) were in or nonvehicle traffic accidents, 26 (2.7%) were penetrating or sharp object injuries. Mortality was most common in men. Also, mortality was observed in 11 (1.14%) cases with a fall from height and then 4 (0.4%) cases in a non-vehicle traffic accident. Abdominal organ injury was mostly in the liver, but mortality was more frequent in spleen injuries. Thoracal, lumbar and simple rib fractures were detected mostly in falls, and hemo and pneumothorax were detected in non-vehicle traffic accidents.

Conclusions: Most of the thoracic and abdominal traumas can be treated by conservative methods. Mortality and morbidity rates can be decreased by determining the multidisciplinary approach of other system injuries and by giving the early decision of procedures.

Keywords: Emergency, pediatric thoracic and abdominal traumas, intra-abdominal organ injuries, mortality

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INTRODUCTION

In the trauma child age group; It is the most important cause of morbidity and mortality in developing and undeveloped countries¹. Anatomical structures and physiology of children are different from adults. Also, their environment and interests vary from age to age. Although the mechanisms and types of accidents in children vary, the most common causes of trauma in children are car accidents, falls, bike accidents, drowning, burns, and child abuse². Traumas that may be so fatal in childhood and which may cause sequelae should be evaluated in terms of causes, age distribution, and treatment algorithms.

The epidemiology of traumas in the region should be well known to establish a viable and life-saving algorithm and determine requirements until the patient is delivered to the hospital. Pediatric patients who were admitted with trauma were followed up and treated by outpatient or inpatient care were examined. Trauma types, injuries, and results are discussed in the light of literature.

MATERIAL AND METHODS

A total of 959 pediatric patients with thoracic and abdominal trauma who were brought to the emergency departments of Sivas Cumhuriyet University Health Services Application and Research Hospital and Sivas Numune Hospital between January 2014 and December 2018, who were followed up or hospitalized, were included in the study.

The study included patients with falls from height, traffic accidents, and sharp object injuries. Gunshot wounds were not included in the study. Patients falling from heights were divided into two groups as falling from heights below 1 meter (-1mF) and falling from heights above 1 meter (+1mD). Traffic accidents were classified into two groups as vehicle traffic accidents and non-vehicle

traffic accidents. Organ injuries were determined by imaging methods (ultrasonography, computed tomography, direct radiography). The patients were retrospectively evaluated for age, gender, causes of trauma, pathologies related to trauma, and mortality reasons.

This study was conducted with the approval of the Sivas Cumhuriyet University Clinical Research Ethics Committee.

Statistical Analysis

The data obtained from this study were analyzed using SPSS 20 package program. While investigating variables from a normal distribution, Shapiro Wilk's was used due to the number of units. Descriptive statistics were shown as mean \pm standard deviation or median (minimum-maximum) for continuous variables, and nominal variables were shown as several cases and percentage (%). Chi-square analysis was applied to examine the relationship between nominal variables among the groups. If the predicted values in the cells of 2X2 tables were not high enough, Fisher's exact test was used, and the Pearson Chi-square test was used with the help of Monte Carlo Simulation to analyze RxC tables. While evaluating the results, 0.05 was used as the level of significance and values below $p < 0.05$ were considered statistically significant.

RESULTS

The mean age of the patients was 9.3 ± 3.1 , and the male / female ratio was 1.38. 58.1% (557) of the patients were male, and 48.1% (402) were female patients (Table 1). The number of male patients was significantly higher ($p < 0.001$). There was no significant difference in trauma types by age. The mean age of the vehicle accident group and the penetrating injuries group was relatively higher (Fig 1).

Table 1: Baseline characteristics of study patients.

Study Patients						All patients	p-	
Baseline Characteristics value								
Age, mean±SD, yr						9.3±3.1	Z=-1.125	0.261
Sex, Female/Male						402/557	X ² =92.637	0.001
Mortality				No	Yes			
				9.3±3.0	9.2±2.8	Z=0.281	0.779	
Trauma Types	-1mF	+1mD	ICTA	NCTA	PCTI	H=2.123	0.713	
	9.3±2.9	9.3±3.0	9.7±3.5	9.1±3.1	9.9±3.5			

-1mF: Falls up to one meter, +1mD: Drops from a meter and more, ICTA: In-car traffic accident, NCTA: Non-vehicle traffic accident, PCTI: Penetrating-cutting tool injury, FR: Fluid Resuscitation p<0.05

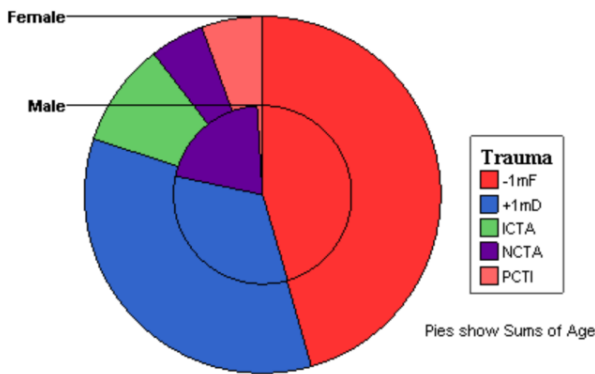


Figure 1: Age distribution of trauma types by gender

Significant differences were found in chi-square test according to whether the types of trauma were determined according to the localization of the thoracic injury (right, left, bilateral), according to the sex, according to the types of rib fractures (single, 2-3, flail chest, sternum injury), according to the presence of hemothorax (Hx) and/or pneumothorax (Px), according to the types of organ injury (liver, spleen, other) According to the results of the study, significant differences were found in the chi-square test (Table 2, Fig. 2).

There was a statistically significant difference in types of injury according to gender. In the vehicle

accident group, there were no male patients, whereas the number of female patients was higher in the penetrating injuries group. The bilateral thoracic injury was more frequent in the +1mD group in terms of thoracic injury type and left thoracic injury was more common in the vehicle accident group. The incidence of right hemithorax injuries was higher in the injuries due to non-vehicle traffic accidents. Unilateral (right + left) thoracic injuries were more frequent in +1mD. Lung contusion was most common in the +1mD group.

It was determined that single-rib fracture was the most common pathology in all trauma types. Sternum fracture was less common in vehicle accidents and penetrating injuries groups. Injury causing flail chest was found to be less in the -1mF and penetrating injuries group.

Px was most frequently seen in the vehicle accident group, but in the -1mF group Px was not seen. Hx was the most common in the nonvehicle accident group, but it was not found in the vehicle accident group. Injuries leading to intraabdominal bleeding were more common in the +1mD and non-vehicle accident group.

Liver injuries were significantly higher in the +1mD group, and splenic trauma was more frequent in the non-vehicle accident group. Other organ injuries (intestine, mesentery, pancreas, etc.) were equally distributed according to trauma types.

Table 2: Chi-square test of trauma types with variables

		Trauma Types					χ^2	p-value
		-1mF n(%)	+1mD n(%)	ICTA n(%)	NCTA n(%)	PCTI n(%)		
Gender	Female	182(19)	140(14.6)	36(3.8)	25(2.6)	19(2)	92.637	0.001
	Male	254(26.5)	183(19.1)	0(0)	113(11.8)	7(0.7)		
Thoracic	No	436(45.5)	317(33.1)	35(3.6)	135(14.1)	26(2.7)	9.708	0.046
	Yes	0(0)	6(0.6)	1(0.1)	3(0.3)	0(0)		
Lumbal	No	436(45.5)	316(33)	34(3.5)	133(13.9)	23(2.4)	28.070	0.001
	Yes	0(0)	7(0.7)	2(0.2)	5(0.5)	3(0.3)		
Thorax	No	420(43.8)	232(24.2)	19(2)	88(9.2)	13(1.4)	153.522	0.001
	Right	6(0.6)	37(3.9)	5(0.5)	25(3.3)	6(0.5)		
	Left	7(0.7)	37(3.9)	9(0.9)	16(1.7)	4(0.4)		
	Bilateral	0(0)	6(0.6)	2(0.2)	4(0.4)	1(0.1)		
Rip fracture	No	526(41.5)	166(13.1)	20(1.6)	30(2.4)	3(0.2)	528.933	0.001
	Single	37(2.9)	170(13.4)	56(4.4)	43(3.4)	6(0.5)		
	2-3 Rip	10(0.8)	61(4.8)	30(2.4)	24(1.9)	2(0.2)		
	Flail	1(0.1)	15(1.2)	16(1.3)	17(1.3)	1(0.1)		
	Chset	4(0.3)	4(0.3)	7(0.6)	2(0.2)	1(0.1)		
Pneumothorax	No	436(45.5)	318(33.2)	34(3.5)	128(13.2)	24(2.5)	35.560	0.001
	Yes	0(0)	5(0.5)	2(0.2)	10(1)	2(0.2)		
Hemothorax	No	434(45.3)	320(33.4)	36(3.6)	133(13.9)	24(2.5)	17.957	0.001
	Yes	2(0.2)	3(0.3)	0(0)	5(0.5)	2(0.2)		
IAB	No	434(45.3)	311(32.4)	34(3.5)	125(13)	22(2.3)	38.239	0.001
	Yes	2(0.2)	12(1.3)	2(0.2)	13(1.4)	4(0.4)		
IAOI	No	433(45.2)	308(32.1)	33(3.4)	123(12.8)	21(2.2)	55.711	0.001
	Liver	2(0.2)	10(1)	0(0)	6(0.6)	3(0.3)		
	Spleen	0(0)	3(0.3)	2(0.2)	6(0.6)	1(0.1)		
	Other	1(0.1)	2(0.2)	1(0.1)	3(0.3)	1(0.1)		
VI	No	435(45.4)	322(33.6)	36(3.8)	133(13.9)	25(2.6)	19.133	0.001
	Yes	1(0.1)	1(0.1)	0(0)	5(0.5)	1(0.1)		
Mortality	No	436(45.5)	312(32.5)	35(3.6)	134(14)	24(2.5)	18.153	0.001
	Yes	0(0)	11(1.1)	1(0.1)	4(0.4)	2(0.2)		

-1mF: Falls up to one meter, +1mD: Drops from a meter and more, ICTA: In-car traffic accident, NCTA: Non-vehicle traffic accident, PCTI: Penetrating-cutting tool injury, FI: Firearm injury, FR: Fluid Resuscitation, IAB: Intraabdominal Bleeding, IAOI: Intra-abdominal organ injury, VI: Vessel injury

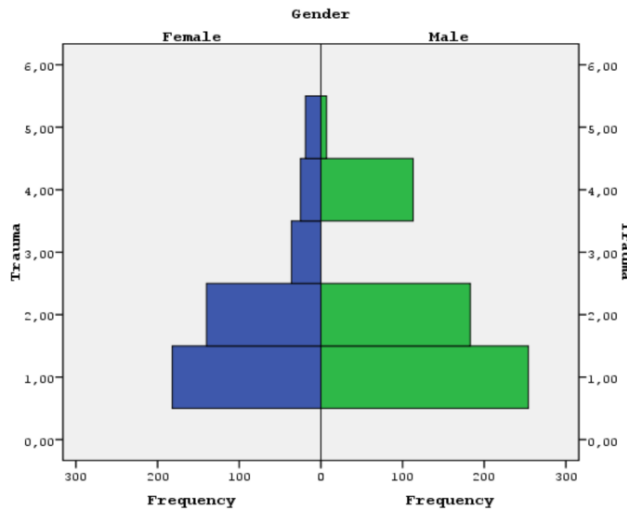


Figure 2: Gender distribution of trauma types

Table 3: Chi-square test of variables with mortality

p-value		Mortality		χ^2	
		No n(%)	Yes n(%)		
0.555	Gender	Female	396(41.5)	6(0.1)	0.456
		Male	545(56.8)	12(1.3)	
0.193	Thoracic	No	931(97.1)	18(1.9)	0.660
		Yes	10(1)	0(0)	
1.508	Lumbal	No	925(96.5)	17(1.8)	0.220
		Yes	16(1,7)	1(0.1)	
16.034	Thorax	No	761(79.4)	11(1.1)	0.003
		Right	76(7.9)	3(0.3)	
		Left	71(7.4)	2(0.2)	
		Bilateral	11(1.1)	2(0.2)	
		Contusion	22(2.3)	0(0)	
23.053	Rip fracture	No	908(94.7)	17(1.3)	0.001
		Single	21(2.2)	0(0)	
		2-3 Rip	5(0.5)	0(0)	
		Flail Chset	4(0.4)	1(0.1)	
		Sternum	3(1.5)	0(0)	
19.893	Pneumothorax	No	922(96.1)	18(1.9)	0.001
		Yes	19(2)	0(0)	
0.232	Hemothorax	No	929(96.9)	18(1.9)	0.630
		Yes	12(1.3)	0(0)	
0.247	IAB	No	909(94.8)	17(1.8)	0.619
		Yes	32(3.3)	1(0.1)	
7.783	IAOI	No	902(94.1)	16(1.7)	0.001
		Liver	21(2.2)	0(0)	
		Spleen	10(1)	2(0.2)	
		Other	8(0.8)	0(0)	
0.154	VI	No	933(97.3)	18(1.9)	0.694
		Yes	8(0.8)	0(0)	
18.153	Trauma	-1mF	436(45.5)	0(0)	0.001
		+1mD	312(32.5)	11(1.1)	
		ICTA	35(3.6)	1(0.1)	
		NCTA	134(14)	2(0.2)	
		PCTI	24(2.5)	4(0.4)	

Significant differences were found in the statistical analysis of mortality about thoracic injury localization, rib fracture types, presence of Px, types of organ injury (Table 3). Not having; thoracic injuries, rib fractures, Px, organ injuries were found to be statistically significant in injuries that did not result in mortality. When the relationship between mortality and trauma types was examined, it was determined that the most common type of trauma that causes mortality was +1mD, and there was no mortality in the -1mF

group and it was found to be statistically significant. There was no statistically significant relationship between sex, intra-abdominal hemorrhage, and presence of Hx and mortality.

DISCUSSION

In our country, as well as in the world, trauma, which is the most common cause of mortality and morbidity in the pediatric age group, is one of the most important health problems ¹. Our study included the evaluation of trauma types and

trauma-induced pathologies of patients in the pediatric age group brought to the emergency department of two health centers and their relationship to mortality.

The causes of traumas, which can cause fatal and permanent disabilities and the fact that they constitute a wide scale ranging from infancy to adulthood in terms of age, have difficulties in terms of creating an algorithm. Anatomical and physiological differences cause trauma to cause different pathologies in children. Factors such as climate, culture, development, season, time of day, and age are effective in the frequency of trauma of children³.

Studies have shown that boys are exposed to more trauma⁴⁻⁶. In our study, trauma was more common in boys, and the most common cause of trauma was -1mF (45.5%). In females, the most common cause of trauma was -1mF (45.3%).

One of the most important groups of patients who applied to the emergency department due to trauma is traffic accidents. The rate of traffic accidents has been reported as 46-59%^{7,8}. However, in our study, it was found that the rate of children brought by traffic accident was 18.1%. In this respect, our study does not show any parallelism with current literature data. This situation was evaluated as a result of the high number of patients in -1mF group in our study and the centers where we conducted the study were easily reached and centralized in terms of transportation.

Since thoracic injuries are a reliable predictor of the severity of injury in children, it is essential to carefully assess children with thoracic trauma. If these injuries are not detected and properly approached, the morbidity risk of children becomes 50% or higher⁹. Pulmonary contusion described by Morgagni in 1971 is a common type of injury due to thoracic trauma. Pulmonary contusion is detected in 17-70% of major injuries^{10,11}. Contusion was found in 2.3% of our patients. The reason for this difference may be that the patients in the literature have more +1mD and vehicle traffic accident groups, and in our study group, 45.5% of the patients were in the -1mF group. Ribs are less mineralized and more flexible in children than they are in adults, so during thoracic trauma, the ribs usually stretch and do not break¹². In our study, rib fractures were seen in a total of 31 patients (3.2%) and were found to be lower than some studies in the literature. It is thought that this case is due to the high number of our cases and the number of patients in the -1mF group compared to the studies in the literature¹³.

14 (45.2%) of the patients who had rib fractures were in the +1mD group. Only 1 (5.5%) of 18 trauma patients with mortality had thoracic trauma (flail chest). In the series of thoracic trauma, the mortality rates detected in the hospital are as low as in our series¹⁴. This may be because many of the thoracic traumas result with death at the place of injury¹⁵.

Abdominal trauma accounts for 10-15% of children's traumas admitted to hospital¹⁶. In our study group, the rate of our patient with abdominal trauma was 3.3%, which is not compatible with the literature, and it is thought that this is due to the high frequency of -1mF group. Mortality was observed in two patients with abdominal trauma, and two patients had splenic injuries.

The rate of pediatric inpatients due to falling in pediatric trauma centers constitutes 25-34% of all child traumas and 6% of children who die from trauma,^{17,18}. Of the patients followed up in our series, 79.1% were trauma cases related to fall, and 11 (1.4%) of these patients had mortality. When the relationship between trauma types and mortality was statistically analyzed, mortality was found to be higher in the +1mD group, and mortality was not observed in the -1mF group.

CONCLUSION

Trauma is a frequent occurrence in emergency departments in the pediatric age group, and trauma types are important for mortality. Therefore, when evaluating trauma patients, questioning trauma types is important in predicting the prognosis of the patient. Fast and urgent evaluation is valuable for survival. It is important to keep in mind that possible organ injuries are more common in certain types of trauma.

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