ISSN: 2717-8161 RESEARCH ARTICLE

New Trend Med Sci 2021; 2(1): 5-9. https://dergipark.org.tr/tr/pub/ntms

Blunt Abdominal Trauma Analysis in the Deaths due to Traffic Accidents in Erzurum, Turkey

Mustafa Talip Sener[1], Talip Vural[1], Yiğit Sezer[2], Ahmet Nezih Kok[1]

[1]Department of Forensic Medicine, Faculty of Medicine, Atatürk University, Erzurum, Turkey
[2]Morgue Department, Council of Forensic Medicine, Erzurum Branch, Erzurum, Turkey

Article History
Received 09 Sep 2020
Accepted 10 Oct 2020
Published Online 25 Jan 2021

****Corresponding Author***
Prof. Dr. Mustafa Talip Sener
Department of Forensic Medicine,
Faculty of Medicine, Ataturk University
25240, Erzurum, Turkey
Phone: +90 442 344 66 33
Fax: +90 442 344 65 68
E-mail: mustafatalipsener@gmail.com
ORCID: https://orcid.org/0000-0002-1295-7710

Abstract: Traffic accidents are one of the most common causes of death in many countries. Death-causing lesions mostly occur in the head-neck, chest, and abdominal region, respectively. Traffic accidents are an important cause of blunt abdominal trauma. Data on abdominal trauma in fatal traffic accidents are limited in autopsy series. In this study, we aimed to determine the frequency of abdominal trauma, the severity of trauma and its effects on the cause of death in traffic accident deaths. A retrospective analysis of autopsy cases of the Morgue Department of the Council of Forensic Medicine, Erzurum Branch between January 2015-June 2019 was conducted. The sample size was determined using the Epi-Info version 7 statistics program. The mean age of the cases was 41.1 years (sd: 23.4; min: 1-max: 96); 76.1% were male. Pre-hospital death occurred in 53.4%, while in the remaining 46.6%, death occurred during hospitalisation. 31.1% of the cases had abdominal trauma. Most commonly injured solid organ was liver in 57.3% of the abdominal trauma cases. Abdominal traumas and liver injuries were more common in pre-hospital deaths, especially in the accident scene deaths ($p<0.001$). Besides, type A liver injury was more common in pre-hospital deaths ($p=0.002$). Liver trauma is one of the leading causes of pre-hospital deaths due to traffic accidents. Type A liver traumas were more lethal.

Keywords: Traffic Accident, Blunt Abdominal Trauma, Pre-Hospital Death, Liver Injury.

1. Introduction

Trauma is one of the leading cause of deaths in Turkey and many other countries. (1, 2) Traumatic deaths mainly occur due to road traffic accidents (3, 4). More than 90% of transportation activities are facilitated by the highways and Turkey is among the top ten countries that almost half of the global traffic accident deaths occured (4).

In blunt traumas, head-neck, chest and abdominal injuries most often occur, respectively. Solid organs such as spleen, liver and kidney are frequently injured in blunt abdominal traumas (5). Approximately 70% of blunt liver injuries are caused by traffic accidents and death occur in 54% blunt liver injuries (6). Data on abdominal traumas in fatal traffic accidents are limited in autopsy series. In this study, we aimed to determine abdominal traumas, abdominal solid organ traumas and the effect of solid organ traumas in the cause of death occurred in fatal traffic accidents.

2. Material and Methods

2.1. Sample Size

The sample size was calculated as 309 cases using the

Cite this article as: Sener MT, Vural T, Sezer Y and Kok AN. Blunt Abdominal Trauma Analysis in the Deaths due to Traffic Accidents in Erzurum, Turkey, *New Trend Med Sci* **2021**; 2(1): 5-9.

Epi-Info version 7 program with a confidence interval of 99.99% and the expected prevalence of 5.4% according to TURKSTAT 2018 traffic accident data (7).

2.2. Selection and Evaluation of the Cases

The autopsy records of the Council of Forensic Medicine, Erzurum Branch between January 2015-June 2019 were examined retrospectively. A total of 309 cases who died due to traffic accident were examined in the study. Demographic data of the cases such as age, sex and traumatic lesions causing death were examined. The severity of liver, spleen, kidney injuries was evaluated according to the 'Organ Injury Severity Scale' of American Association of Surgery for Trauma (AAST) (8). Grade I and Grade II injuries of the liver were considered minor, Grade III and higher grade injuries were considered as major injuries (9). Also, injuries on the left side of the falciform ligament of the liver (segments I, II, III, and IV) were classified as Type A liver trauma, and injuries on the right side of the falciform ligament (segments V, VIII) were classified as Type B liver trauma (10).

The deaths were divided into two groups as pre-hospital deaths and deaths during hospitalisation.

2.3. Statistical Analysis

SPSS Windows 20.0 Software program was used for statistical analysis. The normality test of the data was evaluated by values of skewness and kurtosis. The z-scores were obtained by dividing the skew values or excess kurtosis by their standard errors (11). Comparisons between the groups were analysed with *the chi-square test*, and paired comparisons were analysed with *the student's t-test*. A value of $p<0.05$ was considered statistically significant.

3. Results

76.1% (n=235) of the cases were male, 23.9% (n=74) were female and the mean age was 41.1 (sd: 23.4; min: 1-max: 96). 75.4% (n=233) of the cases were injured in in-vehicle traffic accidents, while 24.6% (n=76) were pedestrian traffic accident deaths. 53.4% (n=165) of the cases were pre-hospital deaths, while 46.6% (n=144) died during hospitalisation. 78.6% (n=243) of the cases were <65 years of age and 21.4% (n=66) were ≥65 years of age. Mean age of pre-hospital death group was 39.1 (±22.8) and deaths in hospital group was 43.5 (±23.9). The mean hospitalization time was 14.3 days (sd: 24.9; min: 1-max: 150) in the hospital deaths. There was no significant difference between the case numbers of age groups of pedestrian traffic accidents ($p>0.05$); however, in-vehicle accident cases were mostly under 65 years of age ($p=0.036$), however there was no such significant difference among the age groups of pedestrian traffic accident deaths.

In 38.2% (n=118) of the cases, the lesions causing death were isolatedly located in one anatomical region, while they were multiply located in more than one anatomical region in other cases. The distribution of death-causing lesions according to anatomical regions is shown in Table 1.

Table 1: Distribution of traumatic lesions according to anatomical regions.

	Isolated* % (n)	Multiple** % (n)	Total % (n)
Head and Neck	17.1 (53)	50.2 (155)	67.3 (208)
Face	0.3 (1)	9.4 (29)	9.7 (30)
Thorax	15.5 (48)	53.7 (166)	69.2 (214)
Abdomen	3.2 (10)	27.8 (86)	31.1 (96)
Upper Extremity	0.6 (2)	9.7 (30)	10.3 (32)
Lower Extremity and Pelvis	1.3 (4)	20.1 (62)	21.4 (66)

*: Cases with death-causing lesions in one anatomical region,
**: Cases with death-causing lesions in more than one anatomical region.

Trauma was detected in the abdominal region in 31.1% (n=96) of the cases. Liver damage was detected in 57.3% (n=55), spleen damage was detected in 36.4% (n=35) and kidney damage was detected in 25% (n=24) of the abdominal traumas. Abdominal solid organ injuries according to the 'Organ Injury Severity Scale' of AAST are shown in Table 2.

Table 2: Abdominal solid organ injuries according to ASST 'Organ Injury Severity Scale'.

Grade	Liver % (n)	Spleen % (n)	Kidney % (n)
Grade 1	7.2 (4)	11.4 (4)	33.3 (8)
Grade 2	11.0 (6)	14.2 (5)	25 (6)
Grade 3	18.2 (10)	20 (7)	16.6 (4)
Grade 4	21.8 (12)	25.8 (9)	16.6 (4)
Grade 5	18.2 (10)	28.6 (10)	8.5 (2)
Grade 6	23.6 (13)	-	-

89.1% (n=49) of the liver traumas occurred in in-vehicle traffic accidents while 10.9% (n=6) occurred in pedestrian traffic accidents and liver traumas occurred mostly in the in-vehicle traffic accidents ($p=0.009$).

When the places of death were compared, pre-hospital death cases were found to be higher in cases under 65 years of age ($p=0.004$) and in cases with liver damage ($p<0.001$). 23.6% (n=13) of the cases with liver trauma had only Type A injury, 56.4% (n=31) had only Type B injury, and 20% (n=11) had both Type A and Type B injuries. Pre-hospital deaths were more frequently observed in the cases with Type A liver injury ($p=0.002$). The traumatic characteristics of the cases according to the place of death are shown in Table 3.

4. Discussion

In our study, we examined death-causing traumatic lesions in fatal traffic accidents. According to the WHO Global Status Report on Road Safety, road traffic injury was the leading cause of death for people aged between 5 and 29 years (12). In our study, traffic accident deaths mostly affected the young male population similar to literature. According to Lee et al., head-neck region is the most frequently injured in blunt traumas and abdominal traumas rank third after thoracic injuries (13). Abdominal trauma ranked also third in terms of frequency after head-neck and thoracic traumas. Spleen is the most frequently injured solid organ in blunt abdominal traumas in many clinical studies (3, 14-20). According to the findings of our study, liver, spleen and kidney are the most frequently damaged solid organs in abdominal traumas, respectively. Other organs may have less damage due to anatomical localisation and organ elasticity such as small-large intestines and bladder.

Table 3: Comparison of the pre-hospital and hospital deaths.

		Pre-hospital death, (n=165) n (%)	Deaths in the hospital, (n=144) n (%)	*p* value
Age	65>	140 (57.6)	103 (42.4)	**0.004**
	65≤	25 (37.9)	41 (62.1)	
	Mean (sd)	39.1 (±22.8)	43.5 (±23.9)	0.096
Gender	Male	127 (54)	108 (46)	0.686
	Female	38 (51.4)	36 (48.6)	
Accident Type	In-vehicle accident	131 (56.2)	102 (43.8)	0.081
	Pedestiran	34 (44.7)	42 (55.3)	
Head-Neck Trauma	Yes	111 (53.4)	97 (46.6)	0.987
	No	54 (53.5)	47 (46.5)	
Maxillofacial Trauma	Yes	17 (56.7)	13 (43.3)	0.706
	No	148 (53.0)	131 (47.0)	
Upper Extremity Trauma	Yes	17 (53.1)	15 (46.9)	0.974
	No	148 (53.4)	129 (46.6)	
Thorax Trauma	Yes	115 (53.7)	99 (46.3)	0.857
	No	50 (52.6)	45 (47.4)	
Abdominal Trauma	Yes	57 (59.4)	39 (40.6)	0.157
	No	108 (50.7)	105 (49.3)	
Liver Trauma	Yes	41 (74.5)	14 (25.5)	**<0.001**
	No	124 (48.8)	130 (51.2)	
Liver Trauma Type	Minor trauma	4 (80)	1 (20)	0.769
	Major trauma	37 (74)	13 (26)	
Liver Trauma Type	Only type A	12 (92.3)	1 (7.3)	**0.002**
	Only type B	20 (64.5)	11 (35.5)	
Spleen Trauma	Yes	20 (57.1)	15 (42.9)	0.637
	No	145 (52.9)	129 (47.1)	
Kidney Trauma	Yes	11 (45.8)	13 (54.2)	0.439
	No	154 (54.0)	131 (46.0)	
Lower Extremity and Pelvis	Yes	30 (45.5)	36 (54.5)	0.145
	No	135 (55.6)	108 (44.4)	

We also detected major injuries more frequently in the liver and spleen, and minor injuries in the kidneys. Although ribs protect the liver, its large size cause the liver to be injured more frequently in blunt traumas (3, 21). In our study, one of the most important reasons why we identified the liver as the most frequently injured solid abdominal organ might be that all of the cases were selected from blunt traumas resulted in death. Most of the studies indicating the spleen damage more frequent were carried out on blunt traumas which did not result in death. Therefore, it can be said that the liver was the most frequently injured solid organ in blunt abdominal traumas resulting in death. According to our findings, the third most frequently injured solid organ in blunt abdominal traumas was kidney. Retroperitoneal localisation of the kidney leads to less injury in blunt abdominal traumas (3, 21).

There is a wide range of pre-hospital death ratios in traffic accidents, from 7% to 45% in the literature and these deaths occurred mostly in rural areas and at the accident scene (22-24). In our study, pre-hospital deaths were observed in 53.4% of the cases and these deaths occurred mostly in the under 65-year-old age group.

Gulliver et al. suggested young people were more likely to be involved in traffic accidents compared to adults [25]. More severe traumas occured due to more aggressive driving behaviours of young males [26]. In our study, in-vehicle traffic accident deaths and pre-hospital deaths were more frequent in the cases younger than 65 years of age.

Liver is the largest solid organ in the abdomen. The thin capsule, low elasticity and fixed position between the vertebrae and ribs makes the liver prone to injury in blunt traumas (3, 21). The centre and usually the right lobe of the liver are damaged as it holds a larger surface in a direct impact to the abdomen by a blunt trauma. The steering wheel may compress the drivers who are not wearing seat belts during the deceleration period when the speed of the vehicle decreases suddenly, and the risk of liver injury may increase significantly in traffic accidents (27). In our study, liver trauma was mostly seen in in-vehicle traffic accidents. Trauma was detected in the right lobe of the liver in the majority of the cases. However, Type A liver injury (left lobe injury) was more common in pre-hospital deaths compared to hospital deaths.

Anatomically, the area on the left side of the falciform ligament is smaller than the area on the right side of the falciform ligament. The anatomical formation of the falciform ligament can control bleeding on the right side of the liver. However, it can not control such bleeding on the left side of the liver. (19). One of the most important causes of the high mortality in liver trauma is uncontrolled bleeding that can cause severe hemorrhagic shock (6, 10). The reason why Type B liver injury (right lobe injury) was more frequently observed may be the anatomically larger right side of the liver. However, higher mortality of Type A liver injury may be due to the lack of the ability of the falciform ligament to control bleedings on the left side of the liver (6, 19). This also explains why Type A liver injury was more common in pre-hospital deaths.

5. Conclusions

The liver is the most frequently injured solid organ in fatal traffic accidents with abdominal trauma. Although Type B liver trauma was more common, Type A liver trauma was more lethal and one of the major causes of pre-hospital deaths due to traffic accidents.

Conflict of Interests

The authors declare that they have no conflict of interest.

Financial Support

The authors declared that this study has received no financial support.

Author Contributions

Şener MT; Conceptualization, investigation, methodology, writing-original draft, writing-review and editing. Vural T: Conceptualization, methodology, formal analysis, investigation, writing-review and editing. Sezer Y: Investigation, writing-original draft, Writing-review and editing. Kok AN: supervision, writing-review and editing.

Ethical Approval

This study was conducted in accordance with Good Clinical Practice guidelines and the principles of the Declaration of Helsinki. Ethics committee approval was obtained for this study (Ethics No: 07.11.2019/01).

References

1. Vyas D, Hollis M, Abraham R, et al. Prehospital care training in a rapidly developing economy: A multi-institutional study. *J Surg Res* **2016**; 203(1): 22-27.
2. Van der Vlies CH, Olthof DC, Gaakeer M, Ponsen KJ, van Delden OM, Goslings JC. Changing patterns in diagnostic strategies and the treatment of blunt injury to solid abdominal organs. *Int J Emerg Med* **2011**; 4(1): 47.
3. Raikwar R, Brahmane A, Arora S. Retrospective and prospective study of management and outcome of blunt abdomen trauma in tertiary health center in last 5-year 2009-2014. *J Evol Med Dent Sci* **2015**; 4(43): 7449-7457.
4. Sungur İ, Akdur R, Piyal B. Analysis of Traffic Accidents in Turkey. *Ankara Med J* **2014**; 14(3): 114-124.
5. Christmas AB, Wilson AK, Manning B, et al. Selective management of blunt hepatic injuries including nonoperative management is a safe and effective strategy. *Surgery* **2005**; 138(4): 606-611.

6. Asensio JA, Demetriades D, Chahwan S, Gomez H, Hanpeter D, Velmahos G, et al. Approach to the management of complex hepatic injuries. *J Trauma Acute Care Surg* **2000**; 48(1): 66.
7. Fahim NK, Negida A, Fahim AK. Sample Size Calculation Guide-Part 3: How to Calculate the Sample Size for an Independent Case-control Study. *Adv J Emerg Med* **2019**; 3(2): 20.
8. Khoshmohabat H, Paydar S, Karami MY, et al. SURGICEL compared with simple gauze packing in grade IV liver injury: an experimental study. *Comp Clin Pathol* **2019**; 28(2): 467-471.
9. Girgin S, Gedik E, Tacyildiz I. Evaluation of surgical methods in patients with blunt liver trauma. *Turkish J Emerg Med* **2006**; 12(1): 35-42.
10. Slotta J, Justinger C, Kollmar O, Kollmar C, Schäfer T, Schilling M. Liver injury following blunt abdominal trauma: a new mechanism-driven classification. *Surg Today* **2014**; 44(2): 241-246.
11. Kim H-Y. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restor Dent Endod* **2013**; 38(1): 52-54.
12. WHO. Global status report on road safety 2018, https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/. [Accessed on 30 October 2019].
13. Lee W-C, Chen C-W, Lin Y-K, et al. Association of head, thoracic and abdominal trauma with delayed diagnosis of co-existing injuries in critical trauma patients. *Injury* **2014**; 45(9): 1429-1434.
14. Wisner DH, Kuppermann N, Cooper A, et al. Management of children with solid organ injuries after blunt torso trauma. *J Trauma Acute Care Surg* **2015**; 79(2): 206-214.
15. Reddy NB, Hanumantha PM, Reddy NN, Reddy CS. An epidemiological study on pattern of thoraco-abdominal injuries sustained in fatal road traffic accidents of Bangalore: Autopsy-based study. *J Emerg Trauma Shock* **2014**; 7(2): 116.
16. Sosada K, Wiewióra M, Piecuch J. Literature review of non-operative management of patients with blunt splenic injury: impact of splenic artery embolization. *Videosurg Other Miniinvasive Tech* **2014**; 9(3): 309.
17. Mehta N, Babu S, Venugopal K. An experience with blunt abdominal trauma: evaluation, management and outcome. *Clin Prac* **2014**; 4(2).
18. Zwingmann J, Schmal H, Südkamp N, Strohm PC. Injury severity and localisations seen in polytraumatised children compared to adults and the relevance for emergency room management. *Zentralbl Chir* **2008**; 133(1): 68-75.
19. Anadol AZ, Topgül K, Güngör B, Bilgin M, Kesim M. Non-operative management of blunt hepatic trauma. *Turkish J Emerg Med* **2007**; 13(3): 222-226.
20. Matthes G, Stengel D, Seifert J, Rademacher G, Mutze S, Ekkernkamp A. Blunt liver injuries in polytrauma: results from a cohort study with the regular use of whole-body helical computed tomography. *World J Surg* **2003**; 27(10): 1124-1130.
21. Soto JA, Anderson SW. Multidetector CT of blunt abdominal trauma. *Radiology* **2012**; 265(3): 678-693.
22. Gholipour C, Rad BS, Vahdati SS, Fahimi R, Amir G, Far LM. Assessment of Causes of Preventable Deaths in Pre-hospital Settings. *Erciyes Med J* **2016**; 38(2): 66-69.
23. Katayama Y, Kitamura T, Kiyohara K, Sado J, Hirose T, Matsuyama T, et al. Prehospital factors associated with death on hospital arrival after traffic crash in Japan: a national observational study. *Bmj Open* **2019**; 9(1).
24. Pfeifer R, Teuben M, Andruszkow H, Barkatali BM, Pape HC. Mortality Patterns in Patients with Multiple Trauma: A Systematic Review of Autopsy Studies. *PLoS One* **2016**; 11(2): 0148844.
25. Yasin MN, Shen Y. Is Road Safety Moving Forward in Europe between 2011–2015?. 19th COTA International Conference of Transportation Proffesionals. *CICTP* **2019**; 3771-3783.
26. Ma CX, Hao W, Xiang W, Yan W. The Impact of Aggressive Driving Behavior on Driver-Injury Severity at Highway-Rail Grade Crossings Accidents. *J Adv Transpor* **2018**; 2018: 984198.
27. Baygeldi S, Karakose O, Özcelik KC, Pülat H, Damar S, Eken H, et al. Factors affecting morbidity in solid organ injuries. *Dis Markers* **2016**; 2016: 6954758.

Authors' ORCID

Mustafa Talip Sener
http://orcid.org/0000-0002-1295-7710
Talip Vural
https://orcid.org/0000-0003-0720-5669
Yiğit Sezer
https://orcid.org/0000-0003-0721-5357
Ahmet Nezih Kok
https://orcid.org/0000-0001-5022-9119

NTMS New Trends in Medicine Sciences
https://dergipark.org.tr/tr/pub/ntms