

# Comparative analysis of two different Turkish hospital reports on polytrauma patients with thoracic trauma

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## ABSTRACT

**BACKGROUND:** The present study aims to assess whether there are any differences in the management and outcome of polytrauma patients with thoracic trauma in trauma units of two different hospitals in the same country; one hospital is near the Syrian border.

**METHODS:** A retrospective analysis (January 2012 to January 2014) of 348 polytrauma casualties with thoracic trauma from Manisa Celal Bayar University Hospital (MH) were compared according to age, gender, mechanism of injury, associated injuries, abbreviated injury scale (AIS), injury severity score (ISS), treatment modalities, and mortality with 917 patients of Şanlıurfa Training and Research Hospital (SH) registry (near the Syrian border).

**RESULTS:** Of the 348 patients in the MH, 230 (66%) and of the 917 patients in the SH, 697 (76%) were males ( $p < 0.001$ ). Mean age was  $45.6 \pm 18.3$  yrs in the MH group and  $26.4 \pm 22.4$  yrs in the SH group ( $p < 0.001$ ). The SH patients had a larger proportion of stab wounds (MH; 9% vs. SH; 17%,  $p < 0.05$ ), gunshot injuries (MH; 5% vs. SH; 18%,  $p < 0.05$ ), higher mean ISS (MH;  $30.2 \pm 8.4$  vs. SH;  $42.8 \pm 10.2$ ,  $p < 0.001$ ), and increased mortality (MH; 2.6% vs. SH; 11.1%,  $p < 0.001$ ). AIS<sub>abdomen</sub> was the highest component in the SH registry (AIS<sub>abdomen</sub> =  $4.8 \pm 0.7$ ), whereas AIS<sub>extremities</sub> were the highest component in the MH registry (AIS<sub>extremities</sub> =  $3.6 \pm 0.2$ ).

**CONCLUSION:** Significantly different demographic features, mechanisms of injury, worse outcomes and higher mortality rates in SH demonstrate and reflect the surgical challenges depending on the combat environment. Two hospitals in Turkey, one seemingly adjacent to a war zone and another with the more standard civilian experience highlight the impact of the Syrian conflict on the Turkish healthcare system.

**Keywords:** Associated injuries; polytrauma; thoracic trauma.

## INTRODUCTION

Despite global efforts, chest trauma still constitutes the third most common cause of death after abdominal injury and head trauma in polytrauma patients.<sup>[1]</sup> This means chest traumas comprise approximately 10–15% of all traumas and directly account for approximately 20–25% of all deaths in polytrauma patients.<sup>[2,3]</sup> Although there are many publications regarding chest trauma, different studies have indicated signif-

icant differences in their morbidity and mortality. Given the differences in the severity and complexity of these injuries, clinicians need to reveal all the possible injuries as quickly as possible. Management of thoracic trauma patients also can sometimes be more different and challenging due to geographic localisation. Knowledge of the common mechanisms and patterns of injury are necessary to predict, treat and prevent traumatic injury.

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Accordingly, we proposed a study that focused on polytrauma patients with thoracic trauma and associated injuries on the thoracic surgery unit of the Manisa Celal Bayar University Hospital (located in the Aegean region of the Anatolia) and Şanlıurfa Training and Research Hospital (located in the Southeast region of Anatolia near the Syrian border) over a three-year period. We selected Şanlıurfa Training and Research Hospital because most of the victims of the Syrian civil war were transferred to this hospital. Besides, we also sought to identify the differences in epidemiology, characteristics, incidence and management of these patients, thus reminding surgeons to pay more attention to the countries' geographic and demographic features.

## MATERIALS AND METHODS

The medical records of polytrauma patients with thoracic trauma of aforementioned hospitals between January 2012 and January 2014 were retrospectively reviewed. AIS scales and Injury severity scores of all patients were calculated.<sup>[4,5]</sup> Patients who were in a state of cardiac arrest or found dead, AIS<sub>chest</sub> 1, AIS<sub>chest</sub> 2, and ISS<16 were not included in this study. Polytrauma was defined as stated by the new Berlin definition.<sup>[6]</sup> Cases with AIS ≥3 for two or more body regions and having at least one or more variables from these five physiologic parameters (hypotension-unconsciousness-acidosis-coagulopathy-age ≥70 years) were included in this study.<sup>[6]</sup> Collected data were compared according to age, gender, mechanism of injury, ISS, AIS, associated injuries, operative procedures and rate of mortality. For the categorical variables, chi-squared test ( $\chi^2$ ), and for comparing the independent variables, a two-sample t-test with a 95% confidence interval was used. P-values <0.05 were denoted significant. All procedures performed in this study were in accordance with the ethical standards of both hospitals and with the 2013 Helsinki declaration. Our hospital's Institutional Review Board approved this study (date: 13.06.2019, no: 33619151/2185). Informed consent was waived since this was a retrospective study.

## RESULTS

Three hundred and forty-eight charts from MH were reviewed with nine-hundred and seventeen charts from the SH registry. The mean age of patients was 45.6±18.3 yrs, with 230 male (66%) in the MH and 26.4±22.4 yrs, with 697 male (76%) in the SH group. There was a male preponderance in the SH group, and patients were significantly younger ( $p<0.001$ ). The predominant mechanism of injury was blunt trauma in each hospital record (MH: n=288; 83% vs. SH: n=573; 63%) but the percentage of patients sustaining penetrating chest trauma was significantly higher in the SH group (n=344; 37% vs. n=60; 17%;  $p<0.001$ ) (Table 1). Statistically significant differences were found in stab wounds (MH; 9% vs. SH; 17%;  $p<0.005$ ) and gunshot injury rates (MH; 5% vs. SH; 18%;  $p<0.005$ ). Motor vehicle crash was most common in both hospital registries, accounting for 53% of MH versus

**Table 1.** Comparison of demographic and clinical variables between MH and SH

	MH	SH	p
Number of the patients	348	917	
Mean age (years±SD)	45.6±18.3	26.4±22.4	<0.001 <sup>a</sup>
Sex, n (%)			
Female	118 (34)	220 (24)	
Male	230 (66)	697 (76)	<0.001 <sup>b</sup>
ISS (±SD)	30.2±8.4	42.8±10.2	<0.001 <sup>a</sup>
AIS chest (±SD)	3.4±0.9	3.9±0.2	<0.001 <sup>a</sup>
Type of the injury, n (%)			
Blunt injury	288 (83)	573 (63)	<0.001 <sup>b</sup>
Penetrating injury	60 (17)	344 (37)	
Mortality, n (%)	9 (2.6)	102 (11.1)	<0.001 <sup>b</sup>

a: t-test; b: Chi-Squared test. SD: Standard deviation; ISS: Injury severity score; AIS: Abbreviated injury scale; MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

**Table 2.** Mechanisms of injury

	MH		SH		p <sup>a</sup>
	n	%	n	%	
Motor vehicle crash	184	53	338	37	<0.05
Pedestrian	52	15	101	11	*
Motorcycle/bicycle	38	11	83	9	*
Gunshot injuries	17	5	165	18	<0.05
Stab wound	32	9	156	17	<0.05
Fall down	14	4	28	3	*
Explosion	4	1	37	4	<0.05
Other	7	2	9	1	*

a: Chi-Squared test. MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

**Table 3.** Abbreviated injury scales (AIS) of injury patterns

	MH	SH	p <sup>a</sup>	95% confidence interval
AIS <sub>chest</sub>	3.4±0.9	3.9±0.2	<0.001	0.44–0.56
AIS <sub>abdomen</sub>	3.3±0.4	4.8±0.7	0.197	0.79–3.79
AIS <sub>head</sub>	1.7±0.7	2.4±0.7	0.195	0.36–1.76
AIS <sub>extremities</sub>	3.6±0.2	4.1±0.4	<0.001	0.46–1.76

a: t-test.

37% in the SH. The number of pedestrians comprised the second largest group of trauma patients, being more in the MH group (15% vs. 11%). Motorcycle/bicycle accident rates

**Table 4.** Pattern of chest injuries

Chest injuries	MH		SH	
	n	%	n	%
Rib fracture	248	65	342	37
Pulmonary contusion	143	37	269	29
Pneumothorax	91	24	321	35
Hemothorax	68	18	253	28
Hemopneumothorax	62	18	183	20
Subcutaneous emphysema	81	21	201	22
Mediastinal emphysema	19	5	83	9
Flail chest	27	7	91	10
Ruptured diaphragm	11	3	45	5
Clavicle fracture	27	7	135	15
Sternal fracture	8	2	46	5
Scapular fracture	23	6	122	13

MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

were nearly equivalent (11% vs. 9%) in the MH and SH patient populations (Table 2).

When we looked at the injury pattern, the severity of chest trauma was significantly different between the MH ( $AIS_{chest}=3.4\pm 0.9$ ) and the SH ( $AIS_{chest}=3.9\pm 0.2$ ) groups ( $p<0.001$ ).  $AIS_{abdomen}$  was the highest component in the SH registry ( $AIS_{abdomen}=4.8\pm 0.7$ ) and was significantly different from the MH ( $AIS_{abdomen}=3.3\pm 0.4$ ) ( $p=0.197$ ), whereas  $AIS_{extremities}$  was the highest component in the MH registry ( $AIS_{extremities}=3.6\pm 0.2$ ) ( $p<0.001$ ) (Table 3).

In the pattern of a chest injury, rib fractures comprised 65% and 37% of MH and SH registry, respectively (Table 4). The incidences of pneumothorax, hemothorax and hemopneumothorax were 24%, 18%, and 18% in the MH, and 35%, 28%, and 28% in the SH database. Pulmonary contusion was the most common pulmonary parenchymal injury and was observed in 37% and 29% of the MH and SH registry. Unstable cases those with flail chest comprised 27 (7%) and 91 (10%) of the MH and SH patients population, respectively. Ten patients (1%) underwent an emergency department thoracotomy (resuscitative thoracotomy) in the SH group. The survival rate for these patients was 20% (2 of 10), and 64 patients (7%) underwent urgent (nonresuscitative) thoracotomy with a survival rate of 67% (43 of 64). Emergency department thoracotomy was not performed in an MH patient population. Eleven patients (3%) underwent urgent thoracotomy, and the survival rate was 91% (10 of 11). Regarding treatment, intercostal tube drainage was the mainstay of treatment in 55% of the MH cases and late thoracotomy was performed in eight cases (3%). Chest tube insertion rate was nearly the same in the SH group (59%), but late thoracotomy was required in 56 patients (6%). Video-assisted thoracoscopic surgery (VATS) was performed in six (1.7%) of MH and 15 (1.6%) of SH cases for various indica-

**Table 5.** Comparison of concomitant injuries

	MH		SH	
	n	%	n	%
Head injuries	52	13	341	37
Hepatic injuries	42	11	146	16
Splenic injuries	39	10	244	27
Stomach perforation	8	2	82	9
Colon perforation	12	3	75	8
Extremity injuries	56	16	351	38
Pelvic bone fracture	50	14	139	15
Spine injury	56	16	230	25

MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

**Table 6.** Distribution of the  $AIS_{chest}$ , comparison of the MH and SH groups

	MH		SH		$p^a$
	n	%	n	%	
$AIS_{chest}$ 3	187	54	282	30	<0.001
$AIS_{chest}$ 4	108	31	390	43	
$AIS_{chest}$ 5	53	15	245	27	

a: Chi-Squared test; MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

tions like removal of a bullet from mediastinum or thorax, for suspected diaphragmatic hernia and removal of the clot.

The most common associated injuries included abdominal injuries (60%), followed by extremities (38%), head injuries (37%), spine injury (25%) and pelvic bone fracture (15%) in the SH database (Table 5). Abdominal injury (26%) was also the leading injury in the MH group, followed by extremities (16%), spine injury (15%), pelvic bone fracture (14%) and head injuries (13.5%). Spleen injury ( $n=244$ ; 27%) was the most common intra-abdominal injury, followed by hepatic injury ( $n=146$ ; 16%), in the SH database, whereas hepatic injury ( $n=42$ ; 11%) was the most common intra-abdominal injury, followed by spleen injury ( $n=39$ ; 10%) in the MH database. 195 (21%) cases in the SH group and 18 (5%) cases in the MH group underwent splenectomy and this difference was statistically significant ( $p<0.05$ ). Laparotomy was performed for hepatic injury in 38 (26%) of the 146 patients (SH group) and five (12%) of 42 patients (MH group). This was also statistically significant ( $p<0.05$ ). The gastrointestinal injury was discovered in 82 (9%) and 75 (8%) of the SH cases compared to eight (2%) and 12 (3%) in the MH group. In 18% of the MH cases, non-thoracic surgical operations had to be performed, whereas it significantly increased to 42% in the SH group.

**Table 7.** ISS correlation with AIS<sub>chest</sub>

ISS	MH	SH	p <sup>a</sup>	95% confidence interval
AIS <sub>chest</sub> 3	25.3±1.8	30.6.0	<0.001	4.86–5.74
AIS <sub>chest</sub> 4	32.4±4.8	41.8±8.4	<0.001	8.46–10.34
AIS <sub>chest</sub> 5	42.6±10.1	57.2±12.7	<0.001	13.11–16.09
Total	30.2±8.4	42.8±10.2		

a: t-test. ISS: Injury severity score; AIS: Abbreviated injury scale; MH: Manisa Celal Bayar University Hospital; SH: Şanlıurfa Training and Research Hospital.

AIS<sub>chest</sub> (±SD) was higher in the SH patient population (SH vs. MH; 3.9±0.2 vs. 3.4±0.9). Given the distribution of AIS<sub>chest</sub>, AIS<sub>chest</sub> 3 (53.6%) was the highest component in the MH registry, whereas AIS<sub>chest</sub> 4 (42.6%) was the highest in the SH group, and this was significantly different (p<0.001) (Table 6). Overall, mean ISS was also significantly different between the MH (30.2±8.4) and the SH (42.8±10.2) groups, and higher ISS was determined with increasing AIS<sub>chest</sub> (Table 7).

In our study, hemorrhagic shock was the leading cause of trauma deaths and the mortality rate in SH patient population was 11.1% (n=102) compared to the MH patient population (2.6%; n=9). The difference in the mortality rate was statistically significant (p<0.001).

## DISCUSSION

This geographical location-based study reports a comparison between the data of thoracic departments of two hospitals located in different regions of Turkey. Manisa is located in Aegean region of Anatolia with a population of 1.41 million and Şanlıurfa located in Southeast region of Anatolia with a population of 1.98 million people. Additionally, Şanlıurfa took 72.601 refugees in 2014 and it was resumed over the past four years.<sup>[7]</sup> Thus, this article is intended to evaluate the differences of trauma patterns in a local manner and provide an overview of the thoracic trauma and associated injuries between these two hospitals.

In the present study, to exclude the minor or clinically insignificant chest injuries, AIS<sub>chest</sub> 1, AIS<sub>chest</sub> 2 and ISS<16 patients were not included in this study. The demographic data of both groups were quite different. Gender, age, mechanism of injury, associated injuries, ISS, AIS and mortality rates were significantly different between the two hospitals. Patients in the SH group were overwhelmingly male (76%) in their second and third decades of life (mean age of SH: 26.4±22.4 yrs), but in the MH group, the rate of male patients were 67% and the majority of patients were in the fourth and fifth decades of life (mean age of MH: 45.6±18.3 yrs).

Motor vehicle crash was the predominant cause of trauma in both of our hospital registries as reported in the literature.<sup>[8–</sup>

<sup>11]</sup> However, the rates of gunshot injuries (18%), stab wound (17%), explosion (4%), (totally (39%) in the SH patients population were more than twice of the MH registry (gunshot injuries: 5%; stab wound: 9%; explosion: 1%; totally: 15%). Comparing both groups in the AIS scale of all body regions, AIS<sub>abdomen</sub> (4.8±0.7) was highest in the SH patient population and AIS<sub>extremities</sub> (3.6±0.2) was highest in the MH patient population. Therefore, it can be assumed that abdominal injury was the most significant injury in the SH group and extremities in the MH patient population. Extremity injuries were generally reported to be the most common diagnosis in patients with multiple trauma.<sup>[12]</sup> This was also in accordance with our MH registry. When we compared the distribution of average AIS<sub>chest</sub>, AIS<sub>chest</sub> 4 (42.6%) was the highest components in the SH registry besides AIS<sub>chest</sub> 3 (53.6%) was the highest component in the MH registry. This may be substantially attributed to the civil war in the neighbouring countries because most of the wounded were transferred from the cross-border to this hospital (SH).

Mortality rate has been reported to vary between 6% and 19% among different studies and usually occurs within the first 24 hours.<sup>[13–15]</sup> In our cohort, the mortality was encountered in 11.1% of the SH patients population and it was nearly fourfold of MH (2.7%) group. Mechanisms of injury, therefore, are considered to be closely related to mortality. Note that SH patients had a significantly higher rate of gunshot injuries and stab wounds and higher ISS.

In many reports, rib fractures were the mainly suffered chest injury occupying approximately 7% to 40% of the cases.<sup>[11,16–18]</sup> In our study, rib fracture was also the most common thoracic injury in accordance with the literature, followed by hemothorax, pneumothorax, lung contusion, and subcutaneous emphysema.<sup>[11]</sup> Surgical stabilisation of the flail chest was performed in cases of failing to wean from the ventilator or when thoracotomy was needed for other reasons (MH 7% vs. SH 10%). The number of rib fractures and associated injuries was reported to increase morbidity and mortality.<sup>[19]</sup> Pulmonary contusion was the most common pulmonary parenchymal injury and was observed in 37% and 29% of the MH and SH registry. This was consistent with the literature.<sup>[20]</sup>

The incidence of concomitant abdominal solid organ injury in thoracic trauma has been reported in the range of 10% and 16%.<sup>[3,21,22]</sup> Blunt liver injury was diagnosed in 146 (16%) of SH patients. The median injury severity score of these patients was 23 (range 18–36), and 38 of 146 patients (26%) underwent laparotomy because of the haemodynamic instability. In the rest, nonoperative management was sufficient. In the MH cohort, the liver injury rate was 11% (42 patients), and only five patients (11.9%) underwent laparotomy. Nonoperative management of blunt liver injuries was reported to have a success rate of between 80–100% in haemodynamically stable patients without an acute abdomen.<sup>[23]</sup> Spleen injury incidence was 27% in SH group and the splenectomy rate was

21%, whereas spleen injury incidence was 10% in the MH group.

The presence of pelvic fracture has previously been related to the severity of trauma and gained acceptance as an indicator of severe injury.<sup>[24]</sup> Giannoudis has reported that with AIS<sub>chest</sub> >2, 21.2% of their patients had pelvic ring injuries.<sup>[25]</sup> In our cohort, the pelvic bone fracture was also higher and associated with 50 (14%) of MH and 139 (15%) of SH registry. Eventually, we think that the higher rates of accompanied extra-thoracic injuries significantly increased the mortality in SH patient population and were the leading cause of mortality.

Ten patients (1%), in the SH group, underwent resuscitative thoracotomy. Two of 10 of our patients (20%) survived. Resuscitative thoracotomy is strongly recommended in patients with no pulse but having signs of life after penetrating thoracic injury.<sup>[26]</sup> However, no patients matched these criteria in the MH patients population. Urgent thoracotomy is infrequent and reported at the rate of 3–15%.<sup>[19,27]</sup> Urgent thoracotomy was performed in 7% and 3% of the patients (SH vs. MH), which was consistent with the literature. Prehospital resuscitative thoracotomy was not performed in both of our territorial fields. Although Nevins et al.<sup>[28]</sup> describes that indications vary by geographical locations, it has not been reported in Turkey yet.

Our study has some limitations. Firstly, both of the hospitals' data were collected retrospectively and the demographic features of the patients were quite different. Concurrently, all data were limited to the national healthcare system. Therefore, the results should be interpreted cautiously. Moreover, intensive care follow-up was not mentioned in our study.

## Conclusion

These differences between MH and SH patient populations may be explained by the combat conditions ongoing in the neighbouring countries. Manisa is far from the border and have not influenced by it so far. Thus, the MH registry was compatible with the literature. However, the SH registry almost completely reflected the transboundary conflicts in the Middle East. Indeed, as indicated throughout this paper, this report reflects the impact of the Syrian conflict on the Turkish healthcare system. For definitive management, a multidisciplinary approach and an improved understanding of trauma at a local level are essential.

**Ethics Committee Approval:** Approved by the local ethics committee (date: 13.06.2019, no: 33619151/2185).

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D.Y., A.H.A., A.B., M.G.P.; Critical revision: S.Y., C.M.T., D.Y., A.H.A., A.B., M.G.P., C.B.

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## ORIJİNAL ÇALIŞMA - ÖZET

### Türkiye'deki iki farklı hastanenin toraks travmalı politravma olgularındaki verilerinin karşılaştırmalı analizi

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**AMAÇ:** Çalışmanın amacı; biri Suriye sınırına yakın olan, ülkemizdeki iki farklı hastanenin travma birimlerinde, toraks travmalı politravma hastalarının yönetiminde ve sonuçlarında farklılık olup olmadığını değerlendirmektir.

**GEREÇ VE YÖNTEM:** Ocak 2012–Ocak 2014 arasında, toraks travmalı politravma geçiren, Manisa Celal Bayar Üniversitesi Hastanesi'ndeki (MH) 348 olgu, Suriye sınırına yakın Şanlıurfa Eğitim ve Araştırma Hastanesi'ndeki (ŞH) 917 olgu ile yaş, cinsiyet, yaralanma mekanizması, eşlik eden yaralanmalar, kısaltılmış yaralanma ölçeği (AIS), yaralanma ciddiyeti skoru (ISS), tedavi yöntemleri ve mortalite açısından geriye dönük olarak analiz edildi.

**BULGULAR:** ŞH olgularında; kesici delici alet yaralanmaları (MH; %9'a karşı ŞH; %17,  $p<0.05$ ), ateşli silah yaralanmaları (MH; %5'e karşı ŞH; %18,  $p<0.05$ ), ortalama ISS (MH;  $30.2\pm 8.4$ 'e karşılık ŞH;  $42.8\pm 10.2$ ,  $p<0.001$ ) ve mortalite (MH; %2.6'ya karşı ŞH; %11.1,  $p<0.001$ ) oranları daha yüksekti. ŞH olgularında en yüksek bileşen AIS karın (AIS karın =  $4.8\pm 0.7$ ) olmakla birlikte, MH olgularında en yüksek bileşen AIS ekstremitelerdi. (AIS ekstremiteler =  $3.6\pm 0.2$ ).

**TARTIŞMA:** ŞH olgularındaki demografik özellikler, yaralanma mekanizmalarındaki farklılıklar ve yüksek mortalite, sınırlarımızdaki ihtilaf bölgesine yakın olmanın getirdiği cerrahi zorlukları göstermekte ve yansıtmaktadır. Ülkemizde biri Suriye sınırına yakın diğeri ise sınıra uzak iki hastanenin verileri, Suriye ihtilafının Türk sağlık sistemi üzerindeki etkisini vurgulamıştır.

**Anahtar sözcükler:** Ek yaralanmalar; politravma; toraks travması.

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