HOSTED BY
ELSEVIER

Contents lists available at ScienceDirect

Journal of Acute Disease

journal homepage: www.jadweb.org

Traumatology http://dx.doi.org/10.1016/j.joad.2015.05.002

Trauma pattern in a level I east-European trauma center

Bogdan Stoica[1], Sorin Paun[1,2*], Ioan Tanase[1], Ionut Negoi[1,2], Mircea Beuran[1,2]

[1]*General Surgery Department, Emergency Hospital of Bucharest, Romania*

[2]*University of Medicine and Pharmacy Carol Davila Bucharest, Romania*

ARTICLE INFO

Article history:
Received 21 Feb 2015
Received in revised form 27 Feb 2015
Accepted 30 May 2015
Available online 29 Jul 2015

Keywords:
Trauma pattern
East-Europe
Trauma registry

ABSTRACT

Objective: To analyze trauma epidemiology, pattern of lesions or death profile in a level I east-European trauma center.

Methods: Prospective observational study of patients admitted to a level I east-European trauma center and enrolled in our trauma registry, between January 2012 to January 2013, was conducted, with the inclusion criteria: (1) trauma lesions, (2) new injury severity score (NISS) higher than 15.

Results: There were 141 patients admitted during the study interval, including 102 (72.3%) males, with a mean age of (43.52 ± 19.00) years, and a mean NISS of 27.58 ± 11.32. The trauma etiology was traffic-related injuries 101 (71.6%), falls 28 (19.9%) and crushing injuries 7 (5.0%). Only one case of gunshot wound was encountered in our study. Out of traffic-related injuries, the automobiles were involved in 56 (55.4%) and motorcycles in 9 (8.9%) patients. The bicyclists accounted for 2 (2.0%) of patients and pedestrians hit by vehicles were in 33 (32.7%) cases. High-velocity falls were found in 7 (25.0%) patients, whereas low-velocity falls accounted for 21 (75.0%) of cases. The overall mortality was 30.00%, and these patients presented the mean NISS of 37.63.

Conclusions: Our trauma pattern profile is similar to the one found in west-European countries, with a predominance of traffic-related injuries and falls. The severity and anatomical puzzle for trauma lesions were more complex secondary to motorcycle or bicycle-to-auto vehicles collisions. A trauma registry, with prospective enrollment of patients, is a very effective tool for constant improvements in trauma care.

1. Introduction

Trauma injuries represent a major challenge for the world-wide healthcare systems[1]. In the European Union, 60 million injured people are managed each year, 7 million of these being admitted into the hospital (1 out of 8.6), with an average hospital stay of 8 days[2]. Periodical assessment of a trauma system, with evaluation of the epidemiological data, can identify the critical areas that may benefit resource allocation, education, provision, and research. A trauma registry has many relevant aspects for trauma care, suggesting the connection between the etiology and outcomes after trauma, and allowing the development of a local, regional and national intervention plan[3]. A functional Romanian national trauma database will allow the appropriate allocation of severely injured patients to tertiary centres and help decrease the mortality rate. A significant improvement in survival of severely injured adults and children was determined by the regionalisation of trauma care and by designation of trauma centers[4–6].

The primary objective was to characterize the major trauma pattern in a level I east-European trauma center while the secondary objectives were: (a) to correlate the anatomic profile of trauma with the trauma kinetics, (b) to correlate the early morbidity and 30-day mortality with the epidemiological data of the injury.

*Corresponding author: Sorin Paun, MD, PhD, Senior Lecturer of Surgery, University of Medicine and Pharmacy Carol Davila Bucharest, General Surgery Department, Emergency Hospital of Bucharest, Romania, No 8 Floreasca Street, Sect 1, 014461, Bucharest, Romania.
Tel: +40 215992308
E-mail: drspaun@yahoo.com

Peer review under responsibility of Hainan Medical College.

Foundation Project: Supported by the Sectoral Operational Programme Human Resources Development, financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/159/1.5/S/137390.

2. Materials and methods

Prospective observational study of patients admitted to the Emergency Hospital of Bucharest over a 1-year period (January 2012 to January 2013) was conducted. Starting from 2012, we have implemented a national trauma registry using variables of the Ulstein Report[7]. Between 2012 and 2014, only one level I trauma center sent patient data to this database[8].

Inclusion criterion was new injury severity score (NISS) higher than 15 while the exclusion criteria were: (a) patients admitted 24 h after the accident, (b) those declared dead before arrival in hospital or with no signs of life on arrival in hospital, (c) asphyxia, (d) drowning and (e) burns.

Data collected and analyzed included demographics, mechanism of injury, trauma scores, prehospital time, time from admission to operating room, clinical exam, blood tests, imagistics, intraoperative findings, in-hospital stay, and mortality. Continuous variables were expressed as mean ± SD, and the categorical ones as number (%). In a sample with normal dispersion, student's *t* test was used for comparison of means. Several independent samples, normally distributed, were examined by using ANOVA tests, to highlight the influence of the considered factor. The probability of rejecting the null hypothesis was set at 0.05. For statistical analysis, we used IBM SPSS Statistics 20 software.

For literature review, we undertook an electronic search of U.S. National Library of Medicine-National Institutes of Health PubMed/MEDLINE, EMBASE, Google Scholar, and ISI Web of Knowledge, to identify original articles and reviews about the subject. The terms of "trauma registry", "trauma pattern", and "trauma epidemiology" were used in various combinations.

3. Results

During the study period, there were 141 trauma patients admitted in the Emergency Hospital of Bucharest, with a NISS higher than 15. There were 102 (72.3%) males, with a mean age of (43.52 ± 19.00) years, and a mean NISS of 27.58 ± 11.32. The mean age of male patients was 41.57 years, and 48.64 years for female patients (Figure 1). About 86 (61%) patients were referred from a lower level trauma center. The trauma etiology was traffic-related causes in 101 (71.6%) cases, falls in 28 (19.9%) and crushing injuries in 7 (5.0%) patients (Figure 2).

Only one case of a gunshot wound was encountered in our study. Out of traffic-related injuries, the automobiles were involved in 56 (55.4%) and motorcycles in 9 (8.9%) patients. The cyclists accounted for 2 (2.0%) of patients and pedestrians hit by vehicles were in 33 (32.7%) cases. The bicyclists hit by car generated the highest ISS. High-velocity falls were found in 7 patients, whereas low-velocity falls accounted for 21 of cases (Table 1). About 5 (3.5%) admissions were due to autoaggressions and 2 (1.4%) due to human aggression. The overall mortality was 43 (30.0%) cases (Table 2).

The mean age of the patients in mortality group was 14 years older than the survivor group (Figure 3), while the mean NISS was 14 points higher (Figure 4).

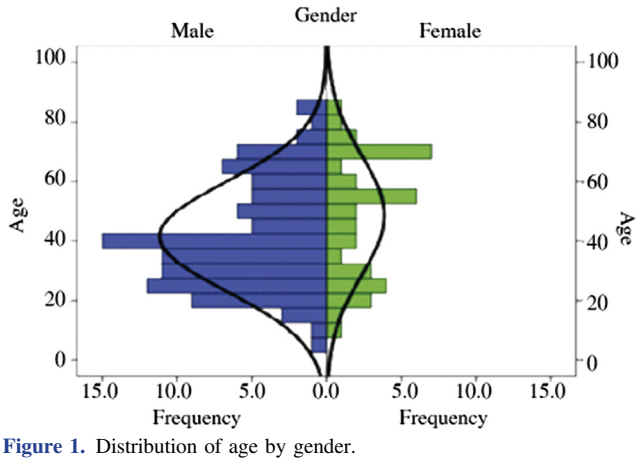

Figure 1. Distribution of age by gender.

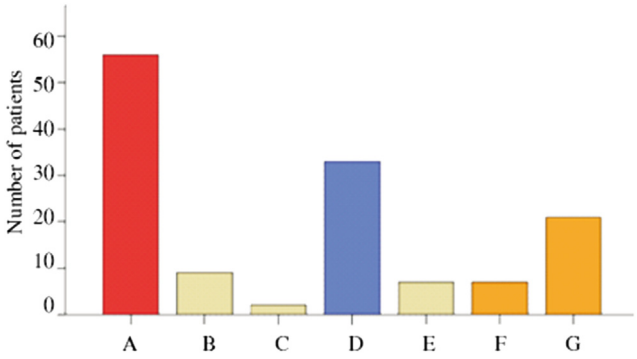

Figure 2. Most frequent trauma patterns encountered in Emergency Hospital of Bucharest.
A: Traffic: automobile; B: Traffic: motorcycle; C: Traffic: bicycle; D: Traffic: pedestrian; E: Crush; F: Fall from height; G: Fall.

Table 1
The mean ISS according to the etiology of trauma.

Cause of injuries	*n*	Mean NISS	SD	95% *CI* for mean		Minimum	Maximum
				Lower bound	Upper bound		
Traffic: automobile	56	27.64	10.736	24.77	30.52	17	57
Traffic: motorcycle	9	27.78	10.497	19.71	35.85	17	48
Traffic: bicycle	2	35.50	9.192	–47.09	118.09	29	42
Traffic: pedestrian	33	29.39	10.805	25.56	33.23	17	57
Traffic: other	1	21.00	–	–	–	21	21
Gunshot	1	17.00	–	–	–	17	17
Crushing injuries	7	29.86	21.729	9.76	49.95	17	75
Fall from height	7	21.71	6.726	15.49	27.93	17	36
Fall	21	25.67	11.888	20.26	31.08	16	57
Other	4	28.00	8.981	13.71	42.29	19	38
Total	141	27.58	11.326	25.70	29.47	16	75

Table 2
Age and NISS distribution according to survival.

	Survival	*n*	Mean	SD	Statistical significance
Age (years)	Deceased	43	53.53	21.193	$P = 0.001$
	Survivor	98	39.13	16.221	
NISS	Deceased	43	37.63	11.882	$P = 0.001$
	Survivor	98	23.17	7.722	

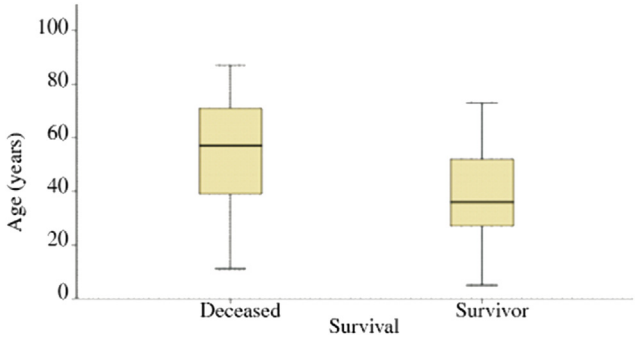

Figure 3. Age of the patients according to the patient survival.

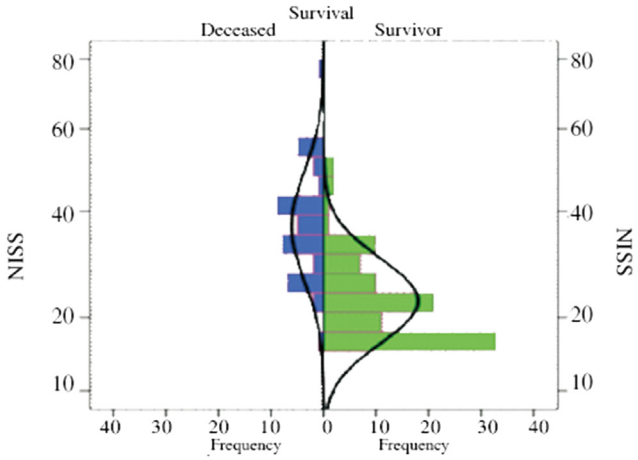

Figure 4. Distribution of NISS according to survival.

4. Discussion

From historical times, mankind has suffered injuries through falls, fire, drowning and interpersonal conflict. While the mechanism and frequency of different specific injuries has changed over millennia, trauma remains an important cause of mortality and morbidity in our modern society[9]. The current evidence shows that trauma injuries are the world's the leading cause of death for patients under 44 years. In western countries, trauma is the fourth leading cause of mortality[10]. Survivors after severe trauma usually face a difficult reintegration into social life as well as a long-term and difficult rehabilitation, with an important socioeconomic burden[11]. The experience of many developed countries proved that trauma care needs high financial and human resources. An analysis of US healthcare costs showed the severely injured patients to be the second group, after heart diseases, summarizing around 10% of the entire US medical expenses[12,13]. In an effort to improve the trauma care, national registries seem to be important, for clinical documentation, quality control, and research. Only an initial management fulfilling the higher standards of quality may offer to polytrauma patients an optimal outcome[14]. Moreover, the descriptive epidemiological records are essential for the audit of negative outcomes.

Starting from two decades ago, the trauma surgeons admitted that standardised data collection and statistics should replace clinical anecdotal evidence. The main purpose would be the improvement of trauma care in pre-hospital and in-hospital settings[15]. Changes in the management of trauma patients were recommended by Sir Miles Irving from the Royal College of Surgeons of England, in 1988, which included "auditing and researching injury and systems of care"[16]. Trauma scoring systems were developed in the following years. Despite their imperfections, trauma scores are a very important tool for patient triage and a research tool in various large national databases[17].

In 1992, the first report evaluating the trauma systems was completed, showing a large inter-hospital variations and an unacceptable delay before treatment[18]. As a consequence, a wide debate was initiated regarding the management of trauma victims. In the following years, trauma registries, such as the English Trauma Audit and Research Network, the German Trauma Register DGU and the US National Trauma Data Bank, collected data systematically. In order to reduce the incidence and magnitude of trauma injuries, it is mandatory to understand what is causing them, apply measures to prevent them, and finally, monitor the effects of the measures taken[19]. Therefore, the database of epidemiologic records about trauma and traumatic injuries is essential[20]. In order to obtain this database, in principle, there must exists dedicated and organized trauma centers, with adequate means and personnel, ready to effectively accept, assess, manage, record and analyze the outcome of trauma patients[21]. During the latest years, a novelty regarding trauma patient care was the introduction of selective nonoperative management of visceral lesions[22].

A recent analysis of the mortality in trauma patients has shown that 5.8 million deaths are caused each year by injuries. World Health Organization data, from 2007, showed that 9% of total annual deaths were caused by injuries, and in 2020 as many as 8.4 million deaths per year are expected[23,24].

In a study from Lausanne University Hospital, the principal mechanisms of trauma were road traffic incidents (RTIs) (40.4%) and falls (34.3%). Two-wheel vehicles (15.6%) account for 38.6% of all RTIs, and the four-wheel vehicles for 19.1% of cases. The pedal cyclists represented 4.1% of the annual trauma workload and 5.4% were pedestrians hit by vehicles (13.4% of all RTIs). In falls from height of more than 1 m, ISS score was higher than 15 in a proportion of 51.2%. Predominant causes were the accidents (85.9%), while 7.8% were due to self-inflicted injuries and 6.3% were due to assault[25]. In our study, the RTIs were encountered in 71.6% and falls from higher or smaller heights in 19.9%.

Also, the car accidents were the most frequently involved comparing to Lausanne University Hospital (15.6% *vs*. 55.4% in Emergency Hospital of Bucharest).

Regarding trauma caused by motorbikes, a study including 13 trauma centers from California, reported a workload of only 4.3%[26]. In our study, the motorbike accidents were encountered in 8.9% of the cases.

In the other side of the world, a study regarding the epidemiology of trauma, from a single Korean trauma center, revealed that most of the trauma mechanisms were classified as blunt trauma, slip-and-fall-down injuries, and vehicle-related accidents (90.8%)[27]. As it was stated by Bulut *et al.* and Lallier *et al.*, trauma injuries were dominated by slip-and-fall-down injuries and vehicle-associated injuries[28,29]. The slip-and-fall-down injuries, among the highest cause of blunt lesions, are secondary to carelessness or suicidal intentions.

Prevention of the trauma, may be done by promoting a safe environment and providing a continuous health education. We have observed a rate of mortality for major trauma patients of

30.5%, similar to the one reported by the group from Laussane (26%), but higher than the one reported by other USA and European centers[30,31]. An important reorganization of trauma care system, has produced a steep drop in the mortality rate (17.5%), as in the case of a trauma center from London, they reported a steep drop in the mortality rate (17.5%) after the reorganization of the system[30]. The same situation has been reported by Germany, with a mortality rate of 18.8% and one from Italy, with a reported rate of 21.0%[31,32]. With the occasion of the 10-year report, the German Society of Emergency Surgery has presented a mortality rate of 11.6%[25].

Our trauma pattern profile is similar to the one found in west-European countries, with a predominance of traffic-related injuries and falls. The severity and anatomical puzzle for trauma lesions were more complex secondary to motorcycle or bicycles accidents than autovehicle collisions. A trauma registry, with prospective enrollment of patients, is a very effective tool for audit and constant improvements in trauma care.

Conflict of interest statement

The authors report no conflict of interest.

Acknowledgments

This paper is supported by the Sectoral Operational Programme Human Resources Development, financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/159/1.5/S/137390. All authors have equally contributed to this study.

References

[1] World Health Organization. International statistical classification of diseases and related health problems. 10th revision. Geneva: World Health Organization; 2010. [Online] Available from: http://www.who.int/classifications/icd/ICD10Volume2_en_2010.pdf [Accessed on 15th January, 2015]

[2] Angermann A, Bauer R, Nossek G, Zimmermann N. Injuries in the European Union-summary 2003–2005. Vienna: European Commission; 2007. [Online] Available from: http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwAssets/7A0E220588591323C1257857003DBDA9/$file/2003-2005-IDB-Report.pdf [Accessed on 10th February, 2015]

[3] Trajano AD, Pereira BM, Fraga GP. Epidemiology of in-hospital trauma deaths in a Brazilian university hospital. *BMC Emerg Med* 2014; **14**: 22.

[4] Sampalis JS, Denis R, Lavoie A, Fréchette P, Boukas S, Nikolis A, et al. Trauma care regionalization: a process-outcome evaluation. *J Trauma* 1999; **46**(4): 565-79.

[5] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A national evaluation of the effect of trauma-center care on mortality. *N Engl J Med* 2006; **354**(4): 366-78.

[6] Hulka F, Mullins RJ, Mann NC, Hedges JR, Rowland D, Worrall WH, et al. Influence of a statewide trauma system on pediatric hospitalization and outcome. *J Trauma* 1997; **42**(3): 514-9.

[7] Ringdal KG, Coats TJ, Lefering R, Di Bartolomeo S, Steen PA, Røise O, et al. The Utstein template for uniform reporting of data following major trauma: a joint revision by SCANTEM, TARN, DGU-TR and RITG. *Scand J Trauma Resusc Emerg Med* 2008; **16**: 7.

[8] Beuran M, Stoica B, Negoi I, Tănase I, Gaspar B, Turculeţ C, et al. Trauma registry – a necessity of modern clinical practice. *Chirurgia (Bucur)* 2014; **109**(2): 157-60.

[9] Beuran M, Negoi I, Paun S, Runcanu A, Gaspar B. [History of trauma care]. *Chirurgia (Bucur)* 2011; **106**(5): 573-80. Romanian.

[10] National Confidential Enquiry into Patient Outcomes and Death. Trauma: who cares? London: National Confidential Enquiry into Patient Outcomes and Death; 2007. [Online] Available from: http://www.ncepod.org.uk/2007t.htm [Accessed on 20th January, 2015]

[11] Finkelstein EA, Corso PS, Miller TR. *The incidence and economic burden of injury in the United States*. Oxford: Oxford University Press; 2006.

[12] Thorpe KE, Florence CS, Joski P. Which medical conditions account for the rise in health care spending? *Health Aff (Millwood)* 2004; http://dx.doi.org/10.1377/hlthaff.w4.437.

[13] Centers for Disease Control and Prevention. Medical expenditures attributable to injuries – United States, 2000. *MMWR Morb Mortal Wkly Rep* 2004; **53**(1): 1-4.

[14] Beuran M, Negoi I, Paun S, Runcanu A, Gaspar B. [Mechanism of injury-trauma kinetics. What happened? How?]. *Chirurgia (Bucur)* 2012; **107**(1): 7-14. Romanian.

[15] Hasler RM, Srivastava D, Aghayev E, Keel MJ, Exadaktylos AK, Schnüriger B. First results from a Swiss level I trauma centre participating in the UK Trauma Audit and Research Network (TARN): prospective cohort study. *Swiss Med Wkly* 2014; **144**: w13910.

[16] Trauma Audit and Research Network. The first decade. Salford: Trauma Audit and Research Network; 2013. [Online] Available from: www.tarn.ac.uk/content/downloads/36/FirstDecade.pdf [Accessed on 2nd February, 2015]

[17] Beuran M, Negoi I, Paun S, Runcanu A, Gaspar B, Vartic M. [Trauma scores: a review of the literature]. *Chirurgia (Bucur)* 2012; **107**(3): 291-7. Romanian.

[18] Yates DW, Woodford M, Hollis S. Preliminary analysis of the care of injured patients in 33 British hospitals: first report of the United Kingdom major trauma outcome study. *BMJ* 1992; **305**(6856): 737-40.

[19] Gunst M, Ghaemmaghami V, Gruszecki A, Urban J, Frankel H, Shafi S. Changing epidemiology of trauma deaths leads to a bimodal distribution. *Proc (Bayl Univ Med Cent)* 2010; **23**(4): 349-54.

[20] Katsaragakis S, Theodoraki ME, Toutouzas K, Drimousis PG, Larentzakis A, Stergiopoulos S, et al. The implementation of a national trauma registry in Greece. Methodology and preliminary results. *J Trauma* 2009; **67**(6): 1421-5.

[21] Leppaniemi A. Current status and future options for trauma and emergency surgery in Europe. *Ulus Travma Acil Cerrahi Derg* 2008; **14**(1): 5-9.

[22] Beuran M, Nego I, Ispas AT, Păun S, Runcanu A, Lupu G, et al. Nonoperative management of high a hepatic trauma in the patient with risk factors for failure: have we gone too far? *J Med Life* 2010; **3**(3): 289-96.

[23] Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: global burden of disease study. *Lancet* 1997; **349**(9064): 1498-504.

[24] World Health Organization. Preventing injuries and violence: a guide for ministries of health. Geneva: World Health Organization; 2007. [Online] Available from: http://www.who.int/violence_injury_prevention/publications/injury_policy_planning/prevention_moh/en/ [Accessed on 15th January, 2015]

[25] Heim C, Bosisio F, Roth A, Bloch J, Borens O, Daniel RT, et al. Is trauma in Switzerland any different? Epidemiology and patterns of injury in major trauma – a 5-year review from a Swiss trauma centre. *Swiss Med Wkly* 2014; **144**: w13958.

[26] Talving P, Teixeira PG, Barmparas G, Dubose J, Preston C, Inaba K, et al. Motorcycle-related injuries: effect of age on type and severity of injuries and mortality. *J Trauma* 2010; **68**(2): 441-6.

[27] Byun CS, Park IH, Oh JH, Bae KS, Lee KH, Lee E. Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single center in Korea. *Yonsei Med J* 2015; **56**(1): 220-6.

[28] Bulut M, Koksal O, Korkmaz A, Turan M, Ozguc H. Childhood falls: characteristics, outcome, and comparison of the injury severity score and new injury severity score. *Emerg Med J* 2006; **23**(7): 540-5.

[29] Lallier M, Bouchard S, St-Vil D, Dupont J, Tucci M. Falls from heights among children: a retrospective review. *J Pediatr Surg* 1999; **34**(7): 1060-3.

[30] Davenport RA, Tai N, West A, Bouamra O, Aylwin C, Woodford M, et al. A major trauma centre is a specialty hospital not a hospital of specialties. *Br J Surg* 2010; **97**(1): 109-17.

[31] Chiara O, Cimbanassi S, Andreani S, Sammartano F, Pizzilli G, Girotti P, et al. [The model of the Niguarda Hospital Trauma Team in Milan]. *Chir Ital* 2008; **60**(5): 627-40. Italian.

[32] Saltzherr TP, Visser A, Ponsen KJ, Luitse JS, Goslings JC. Complications in multitrauma patients in a Dutch level 1 trauma center. *J Trauma* 2010; **69**(5): 1143-6.