G Model
JCOT 498 No. of Pages 7

ARTICLE IN PRESS

Journal of Clinical Orthopaedics and Trauma xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Clinical Orthopaedics and Trauma

journal homepage: www.elsevier.com/locate/jcot

Grouping of body areas affected in traffic accidents. A cohort study

Alba Luz León[a], Johana Ascuntar-Tello[a], Carlos Oliver Valderrama-Molina[b], Nelson Darío Giraldo[b], Alfredo Constaín[c], Andrés Puerta[b], Camilo Restrepo[a], Fabián Jaimes[d,*]

[a] Universidad de Antioquia, Medellín, Colombia
[b] Hospital Pablo Tobón Uribe, Medellín, Colombia
[c] Universidad de Antioquia and Hospital Pablo Tobón Uribe, Medellín, Colombia
[d] Universidad de Antioquia and Senior Investigator Research Unit, Hospital Pablo Tobón Uribe, Medellín, Colombia

ARTICLE INFO

Article history:
Received 5 September 2017
Received in revised form 13 November 2017
Accepted 23 November 2017
Available online xxx

Keywords:
Clustering
Traffic accident
Body
Trauma

ABSTRACT

Background: Traffic accidents are considered a public health problem and, according to the World Health Organization, currently is the eighth cause of death in the world. Specifically, pedestrians, cyclists and motorcyclists contribute half of the fatalities. Adequate clinical management in accordance with aggregation patterns of the body areas involved, as well as the characteristics of the accident, will help to reduce mortality and disability in this population.
Methods: Secondary data analysis of a cohort of patients involved in traffic accidents and admitted to the emergency room (ER) of a high complexity hospital in Medellín, Colombia. They were over 15 years of age, had two or more injuries in different areas of the body and had a hospital stay of more than 24 h after admission. A cluster analysis was performed, using Ward's method and the *linfinity* similarity measure, to obtain clusters of body areas most commonly affected depending on the type of vehicle and the type of victim.
Results: Among 2445 patients with traffic accidents, 34% (n = 836) were admitted into the Intensive Care Unit (ICU) and the overall hospital mortality rate was 8% (n = 201). More than 50% of the patients were motorcycle riders but mortality was higher in pedestrian-car accidents (16%, n = 34). The clusters show efficient performance to separate the population depending on the severity of their injuries. Pedestrians had the highest mortality after having accidents with cars and they also had the highest number of body parts clustered, mainly on head and abdomen areas.
Conclusions: Exploring the cluster patterns of injuries and body areas affected in traffic accidents allow to establish anatomical groups defined by the type of accident and the type of vehicle. This classification system will accelerate and prioritize ER-care for these population groups, helping to provide better health care services and to rationalize available resources.

1. Introduction

Since 1974, the General Assembly of the World Health Organization (WHO) adopted resolution WHA27.59 to declare traffic accidents as a severe public health problem.[1] According to the WHO, every year traffic accidents cause 1.20 million fatalities in the world. This was mainly in the age group ranging from 15 to 29 years. From 20 to 50 million people sustain non-fatal injuries and a significant proportion of these will have some sort of remaining disability. Ninety one percent of traffic-related deaths were in low and middle-income countries, which despite being a vast majority barely have half of the vehicles registered in the entire world.[2,3] The WHO estimates that for 2028 traffic accidents will cause 1.8 million fatalities a year.[2] Currently, traffic accidents are the eighth cause of death in the world, and it is foreseen that for 2030, they will become the fifth.[4]

Africa is the region that has the highest traffic-related mortality rate, 24.1 fatalities per 100,000 inhabitants, and Europe has the lowest, 10.3 fatalities per 100,000 inhabitants.[4] According to the Basic Health Indicator report in the Americas for 2012, Latin

* Corresponding author at: Department of Internal Medicine, Universidad de Antioquia, Calle 64 № 51D-154 – Block 7 - Second floor, Medellín, Colombia.
E-mail addresses: albaluz3105@gmail.com (A.L. León), yomers02@gmail.com (J. Ascuntar-Tello), cvalderrama@hptu.org.co (C.O. Valderrama-Molina), nelsondariogiraldo@gmail.com (N.D. Giraldo), aconstain@hptu.org.co (A. Constaín), andrespuertagomez@gmail.com (A. Puerta), camilo.75@hotmail.com (C. Restrepo), fabian.jaimes@udea.edu.co (F. Jaimes).

https://doi.org/10.1016/j.jcot.2017.11.012
0976-5662/© 2017

America reported a 17.6 mortality rate per 100,000 inhabitants and Colombia reported a 17.9 mortality rate.[5]

Half of the people that die in traffic accidents in all the world are pedestrians, cyclists and motorcyclists which are known as vulnerable users[2]. In Colombia in 2013, the Institute of legal medicine received 48,042 reports of cases of traffic accidents in which there were 6219 fatalities, most of them motorcycle related (44.3%) and pedestrians (29.3%).[6]

From an anatomic perspective and in reference to the kinematics of the trauma, it should be possible to characterize the injuries sustained in traffic accidents in accordance with the type of vehicle (automobile, motorcycle, others) and the type of victim (driver, passenger, pedestrian). This would be a great help in starting to provide medical care because prior knowledge focuses on the more affected body area, according to the nature of the accident and the type of victim, would help to perform more accurate management which would reduce mortality and disability. In the literature, all of the studies that were reviewed presented their information separately depending on the type of victim (driver, passenger or pedestrian) and reported small sample sizes. Leong et al., found in a group of 682 patients that young passengers, representing 14% of the total, have the highest mortality rate and contributed significantly to the death rate among young motorcycle casualties.[7] Kui et al. conducted a study with 109 pedestrians, where they found pedestrians hit by a minibus had a high proportion of head, chest, and extremity injuries with 84.4%, 50.5%, and 52.3%, respectively.[8] On the other hand, Nathens et al. found that ten years following initial trauma system implementation, mortality due to traffic crashes began to decline, mainly because of the development of prehospital triage criteria, interfacility transfer protocols and quality assurance.[9]

Therefore, it would be very useful to construct clusters of simple anatomic areas, easy to identify and consistent with the type of traffic accident victim, with a bigger sample size that the reported in literature. Whence our aim was to explore the aggregation patterns of injuries and the zones of the body affected in traffic accidents and establish, using cluster analysis, possible combinations according to the type of vehicle and the type of victim.

2. Methods

2.1. Design

a secondary data analysis was conducted on a bi-directional cohort of patients treated from January 2007 to August 2015 at a high complexity hospital in the city. For the retrospective cohort, we reviewed the electronic clinical records of the patients admitted to the ER from January 1, 2007 and October 31, 2013. For the prospective cohort, we reviewed the electronic clinical records of the patients admitted to the ER from November 1, 2013 to July 31, 2015.

2.2. Participants

patients were designated eligible if they were over 15 years of age, had two or more injuries in different areas of the body (1. Head/neck/cervical spine, 2. Face, 3. Thorax/thoracic spine, 4. Abdomen/lumbar spine, 5. Limbs/Pelvis, 6. External areas) and a hospital stay of more than 24 h after being admitted to the ER. Patients having injuries resulting from an event which was not a traffic accident were excluded, as well as those patients who had already participated in the study. The study was approved by the Ethics Committee of the Medical Research Institute of the School of Medicine at Universidad de Antioquia (Medellín) and the participating hospital.

2.3. Data source

retrospective data were reviewed using electronic clinical records based on a report issued by the information management department. This report was constructed based on five corporal areas from the ICD-10 diagnostic codes: face S02; head and neck S02, S06, S09, S10 and S19; thorax, S20 to S29; abdomen S30 a S39; limbs S42, S72, S73, S75, S78, S82, S83, S85 and S88. In addition, the report also considered patients with general trauma codes (T01 to T07) and war or blast code Y36. For prospective data, there was a trained nurse in charge of patient recruitment and follow-up during hospitalization. The data collected included clinical, demographic and trauma-related characteristics; a description of the different injuries a patient sustained, trauma scoring and body areas affected; the need to be admitted to the ICU, mechanical ventilation, hospital stay and hospital mortality. The entire process from admission, data collection, follow-up and the classification of injuries was confirmed by a qualified trauma-related experienced co-researcher assigned weekly to the study. Case report forms (CRF) were delivered to the Data Coordinating Center (DCC) weekly to verify data clarity and consistency. Any error or lack of information meant returning the CRF to the assistant to review it with the co-researcher in charge. The severity of patients' injuries were classified in accordance with ISS (Injury Severity Score),[10] NISS (New Injury Severity Score),[11] RTS (Revised Trauma Score)[12] and TRISS (Trauma and Injury Severity Score).[13]

Table 1
General characteristics of study population.

	n = 2445
Age (mean ± SD), years	36 ± 16
Male	1973 (81%)
Referred	711 (29%)
Accident Variables	
Type of Victim	
Driver	1449 (59%)
Passenger	439 (18%)
Pedestrian	557 (23%)
Type of Vehicle	
Automobile	414 (17%)
Motorcycle	1942 (79%)
Others[a]	89 (4%)
Clinical Variables	
Systolic BP, mm Hg	125 (113–140)
Heart rate, beats/min	88 (78–100)
Respiratory rate, breaths/min	18 (16–20)
Glasgow coma scale	15 (12–15)
Lactate, mmol/L (n = 1061)	2.7 (1.7–3.9)
PT, secs (n = 1152)	12.4 (11.4–13.8)
Scores	
ISS	13 (9–21)
NISS	17 (11–27)
RTS	7.84 (6.90–7.84)
TRISS	4.47 (2.98–5.05)
Outcomes	
Admitted to the ICU	836 (34%)
Mechanical ventilation	746 (31%)
Length of hospital stay, days	6 (3–15)
Hospital mortality rate	201 (8%)

Continuous variables are presented as medians (IQR), unless otherwise indicated. PT: prothrombin time, ISS: injury severity score, NISS: new injury severity score, RTS: revised trauma score, TRISS: trauma revised and injury severity score, ICU: intensive care unit.

[a] Others: includes bicycle riders, skaters and skateboards.

Please cite this article in press as: A.L. León, et al., Grouping of body areas affected in traffic accidents. A cohort study, J Clin Orthop Trauma (2017), https://doi.org/10.1016/j.jcot.2017.11.012