International Journal of Life Science Research Archive

ISSN: 0799-6640 (Online)

Journal homepage: https://sciresjournals.com/ijlsra/

(RESEARCH ARTICLE)

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Helmet: A device to reduce mortality and severity of trauma

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International Journal of Life Science Research Archive, 2022, 03(01), 093–100

Publication history: Received on 13 July 2022; revised on 29 August 2022; accepted on 31 August 2022

Article DOI: https://doi.org/10.53771/ijlsra.2022.3.1.0077

Abstract

Introduction: Objective of the present study was to evaluate the nosocomial outcomes and severity of trauma among motorcyclist trauma patients with and without using helmet.

Materials and Methods: A prospective descriptive study was performed on 1000 motorcyclist trauma patients between December 2019 and May 2021. After collecting data and recording patients' outcomes, patients were divided into two groups of users and non-users of helmets, and patients' outcomes and severity of trauma were evaluated.

Results: The median age of patients was 27 years and only 36.2% of patients had worn helmet when they were traumatised. Of the patients, 41 died during hospitalization, out of which 36 individuals did not have helmet during trauma. In the group without a helmet, the most common sites of injury were head and neck. There was a significant difference in the severity of trauma based on GAP, RTS, and NTS in the two groups of patients ($P < 0.05$). In reviewing the GAP, RTS, and NTS models, in determining the prognosis of survival rate of patients, the cut-off point values were obtained as 18.5, 7, and 16.5, respectively, with the area under the curve ROC of about 0.95.

Conclusion: Helmet plays an important role in reducing the hospital mortality rate of motorcycle trauma patients. Additively, wearing a helmet is very effective in reducing the severity of trauma. It is recommended to take necessary measures to increase the use of helmet among motorcyclists by training and also using the force of law.

Keywords: Multiple Trauma; Mortality; Outcome; Emergency Ward; Motorcycles

1. Introduction

One of the most important health problems is injury from road vehicles. Accidents and trauma cause physical and psychological damage and also causes economic capital losses; therefore, effective and sustainable measures should be taken to prevent them [1-3]. According to the World Health Organization, deaths from traffic accidents have increased by 10%, mostly in low- and middle-income countries. In Iran, the number of traffic accidents has increased by 10% and the death rate of traffic accidents is increased [1].

Among road users, motorcyclists are considered to be high-risk road users because they experience more injuries after crash. Even in developed countries, motorcyclists usually make up about 20 times higher risk of mortality in comparison with other motor-vehicles [4], while in Iran this rate is 23.8% [5] and the second leading cause of death in road traffic

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accidents [6]. The most common cause of death for motorcycle occupants during traffic accidents is head injury. Using a helmet is one of the best and easiest ways to reduce the level of damage in motorcycle accidents. In developing countries, there is a problem of not using helmets and also improper use of them. Only one third of motorcyclists use it properly [7]. Wearing a helmet in the event of an accident reduces the risk of concussion and fatal accident, as well as reducing the possibility of strike of objects and suspended particles on the head and face [1]. According to the available data, the impact of helmet use on neck spinal cord injury is controversial [8]. Some of the studies show increased risk of neck injuries in motorcyclists who wear helmet like Goldstein study [9].

Trauma patients usually suffer from unpredictable and hidden injuries that are not diagnosed in the early hours after the injury [10]. To increase the survival of patients, they should be sent to appropriate medical center immediately and definite and immediate care should be started for them. Therefore, rapid and initial evaluation of patients is very important and necessary [11].

The use of simple systems for scoring the level of trauma help physicians to decide the patients' treatment at the scene of the accident and before transferring the patient to the hospital to decide on the route of transfer and choose the appropriate medical center. Additively, they help physicians in hospital emergency room to predict the prognosis and severity of trauma in patients. It also helps for making decision about transferring the patients to the operating room and informing the patients' families about their conditions [12].

Objectives

Considering that many types of researches have shown the ineffectiveness of helmets and even their usefulness for reducing the risk of cervical spinal cord injuries in those who have worn helmets [13, 14]. The objective of this study was to evaluate the hospital outcomes and severity of trauma among motorcyclist trauma patients as well as the effect of helmet use on them.

2. Material and methods

2.1 Participants

During a prospective descriptive-analytical study in the emergency department of Referral Trauma Medical Center affiliated to the University of Medical Sciences, 1000 motorcyclist trauma patients were enrolled in the period between December 2019 and May 2021.

2.2 Study Design

Inclusion criteria included all motorcyclist trauma patients over 18 years of age and exclusion criteria included traffic trauma due to other causes and unwillingness to participate in the study. To calculate the sample size, we used the results of Rahmani et al. study [15]; in this study, the sensitivity of 0.95 and specificity of 0.95 for GAP score was reported to determine the prognosis of multi-trauma. According to the prevalence of trauma patients referring to the emergency department, which was available in hospital statistics, with a confidence interval of 0.95, the minimum sample size in this study was calculated to be 1000 patients. The sampling method was full census until reaching the final sample size. This study was approved by the Research Ethics Committee of Tabriz University of Medical Sciences with the code IR.TBZMED.REC.1397.691 on 19.11.2018.

2.3 Data Gathering

At the beginning of the admission of patients, the demographic characteristics including age, sex, vital signs, place of trauma, mechanism of trauma, and use of the helmet were recorded. Patients' outcome was recorded at discharge from the hospital, including death or survival. Trauma severity was calculated based on GAP (GCS, Age, and Pressure) and NTS (New Trauma Score) scores [15-17]. Patients were divided into two groups based on helmet use and hospital outcome; recorded variables and patient outcomes were compared in the two groups.

2.4 Statistical Analysis

Data were analyzed using SPSS-17 software. Mean ± standard deviation was used to describe quantitative data and frequency and percentage were used to describe qualitative data. Normal distribution of quantitative variables were evaluated by Kolmogorov-Smirnov test. A Chi-square statistic test was used to analyze qualitative data and an independent sample T-test were used to compare quantitative data. To determine the predictive value of GAP and NTS

scores, the ROC curve (Receiver Operating Characteristic Curve) was used and the cut-off point, sensitivity, and specificity were determined with 95% confidence. In all cases, P-value<0.05 was considered significant.

3. Results

In this study, 1000 people entered the study. 948 (94.8%) were male and the rest were female. Of all patients, 41 (0.41%) died during hospitalization, all of whom were male. The median age and the first and third quarters in all patients (22-23) were 27, with minimum age of 17 and maximum age of 80 years. 362 people (36.2%) had worn helmets, of which 5 (12.2%) died and 357 (37.2%) survived. There was a statistically significant difference between the two groups (p <0.05).

Table 1 Comparison of demographic variables and vital signs between the two groups of patients

Variables	With mortality (N=41)	Without mortality (N=959)	P value
Age	26.17±5.36	30.03±11.15	0.028*
Gender			0.266#
Male	41 (100%)	907 (94.6%)	
Female	0 (0%)	52 (5.4%)	
Vital signs			<0.001*
Heart rate (/minute)	105.36±17.92	87.11±8.65	
Respiratory rate (/minute)	22.88±3.62	18.61±2.18	
MAP (mmHg)	78.80±19.63	89.21±8.75	
GCS	6.80±2.80	14.48±1.94	
O2 Saturation (%)	91.02±3.99	95.02±1.93	

MAP: Mean Arterial Pressure; GCS: Glascow Coma Scale; *Independent sample's T test; # Fisher's Exact Test

Table 2 Comparison of the variables related to the accident between the two groups

Variables	With mortality (N=41)	Without mortality (N=959)	P value
Helmet use			<0.001*
Yes	5 (12.2%)	357 (37.2%)	
No	36 (87.8%)	602 (62.8%)	
Mechanism of trauma			<0.001#
Motor to car	7 (17.1%)	650 (67.8%)	
Rollover	20 (48.8%)	263 (27.4%)	
Others	14 (34.1%)	46 (4.8%)	
Place of trauma			<0.001#
Inner city	6 (14.6%)	702 (73.2%)	
Road	30 (73.2%)	239 (24.9%)	
Highway	5 (12.2%)	18 (1.9%)	
Injury site			<0.001#
head&face	36 (87.8%)	185 (19.3%)	
spine	1 (2.4%)	30 (3.1%)	
Trunk	0 (0%)	67 (7 %)	

upper extremities	1 (2.4%)	180 (18.8%)	
lower extremities	3 (7.3%)	497 (51.8%)	
ED disposition			<0.001#
Discharge	0 (0%)	16 (1.7%)	
Admission	30 (73.2%)	943 (98.3%)	
Death	11 (26.8%)	0 (0%)	
ICU admission			<0.001*
Yes	30 (73.2%)	180 (18.8%)	
No	11 (26.8%)	779 (81.2%)	
GOS			<0.001#
Death	41 (100%)	0 (0%)	
Vegetative State	0 (0%)	4 (0.4%)	
Severe disability	0 (0%)	88 (9.2%)	
Moderate disability	0 (0%)	172 (17.9%)	
Recovery	0 (0%)	695 (72.5%)	

ED: Emergency Department; ICU: Intensive Care Unit; GOS: Glascow Outcome Scale; * Fisher's Exact Test; # Chi square

Table 3 Comparison of trauma severity between two groups (helmet use)

Variables	With helmet (N=362)	Without helmet (N=638)	P value
GAP	22.91±1.51	21.80±3.26	<0.001#
GAP category			<0.001*
Mild	356 (98.3%)	554 (86.8%)	
Moderate	6 (1.7%)	80 (12.5%)	
Severe	0 (0%)	4 (0.6%)	
NTS	22.35±1.62	21.09±3.42	<0.001#
NTS category			<0.001*
Low	354 (97.8%)	551 (86.4%)	
Moderate	7 (1.9%)	66 (10.3%)	
High	1 (0.3%)	22 (3.3%)	
Very high	0 (0%)	0 (0%)	
RTS	7.80±0.29	7.53±0.85	<0.001#
Mortality (hospital)			<0.001^
Yes	5 (1.4%)	36 (5.6%)	
No	357 (98.6%)	602 (94.4%)	

#Independent sample's T test; * Chi square; ^ Fisher's Exact Test

Table 1 shows a comparison of demographic variables and vital signs between the two groups of patients with and without mortality. As it is obvious from the table, in all cases except the age variable, there was a statistically significant difference between the two groups of patients (P <0.05). Table 2 shows a comparison of the variables related to the accident and the severity of trauma between the two groups. Mortality rate was high on roads crash and following rollover and head injuries, as shown in the table study, there is a statistically significant difference between the two groups in all variables (P <0.05). To determine the effect of using helmets, patients were divided into two groups based on helmet use. The comparison of variables between these two groups is given in Table 3. There was a statistically

significant difference between the two groups (based on helmet use) in terms of severity of trauma and mortality (P <0.05).

ROC curve was used to determine the value of GAP, NTS, and RTS trauma severity scores in the patients' survival (Figure 1). The interpretation of this curve is given in Table 4. Based on Table 4 and considering the sub-curved surface of the diagrams, almost all scores had equal values in the prognosis of patient survival.

Table 4 Determination the value of GAP, NTS, and RTS trauma severity scores in patients' survival

Score	Cut off point	AUC (95% CI)	Sensitivity	Specificity
GAP	18.5	0.945 (0.895-0.995)	0.946	0.951
NTS	16.5	0.950 (0.902-0.997)	0.946	0.951
RTS	7	0.959 (0.920-0.999)	0.942	0.951

AUC: Area under Curve; CI: Confidence Interval;

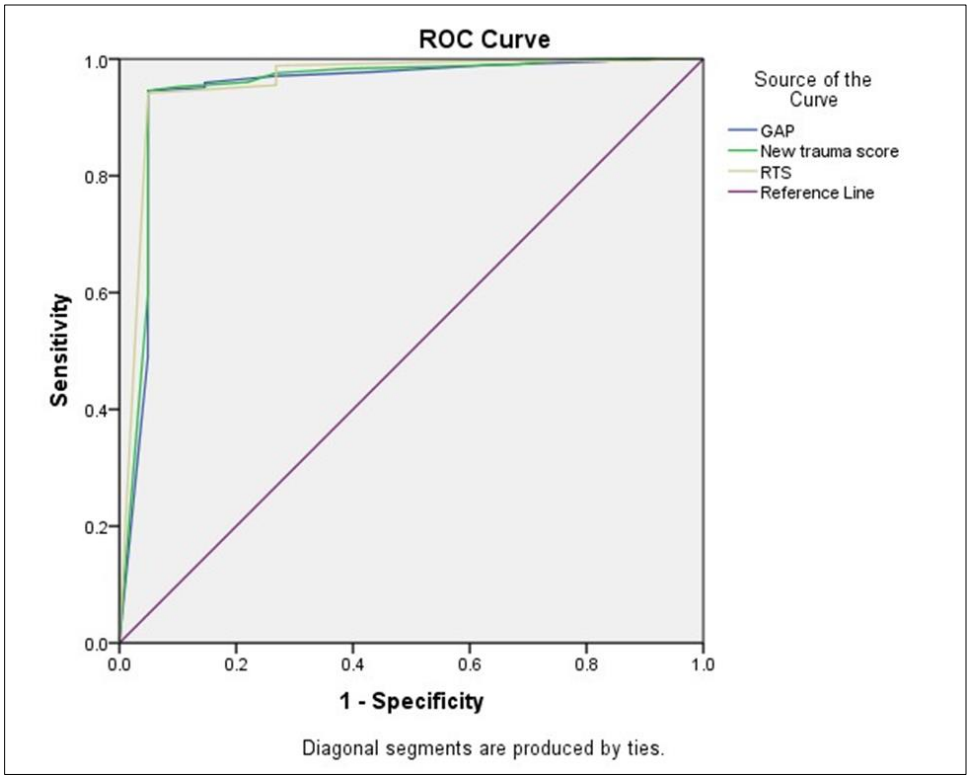

Figure 1 Value of GAP, NTS, and RTS in predicting survival of patients

4. Discussion

The objective of this study was to evaluate the hospital outcomes and severity of trauma in motorcyclist trauma patients and also the effect of helmet use on them. The results showed that the use of helmets has a positive effect on reducing the severity of the trauma, reducing mortality and reducing head and neck injuries.

Trauma is one of the leading causes of primary disability and death in the world. Most trauma deaths usually occur in the early hours or before arriving to the hospital. Injury from severe trauma can be minimized by rapid initiation of treatment and care of the trauma patient. This is possible by using scoring systems. The scoring systems can easily assist emergency care providers in identifying the severity of lesions and managing trauma patients [3]. Trauma scoring has long been considered as an important component of pre-hospital triage. It can be useful for prediction of mortality and severity of injury resulting from trauma, and help physicians in assessing patients to provide appropriate care [15, 18].

About road traffic accidents, 59.7% of them were related to motorcycle accidents, which were the main cause of death from head injuries due to not wearing a helmet. It seems that head trauma and its severity cannot be completely prevented, however, wearing a helmet properly can reduce the severity of the injury. Female motorcyclists wore helmets more than males which might have been due to specific behavioral differences between the sexes in road habits. People with higher levels of education had fewer offenses and tended to follow the law more than people with lower levels of education. Therefore, according to the results of studies, to promote the proper use of helmets, training should be focused on men, young people without a motorcycle license, and those who have had a previous accident experience [19]. According to studies, due to the lack of helmet use, 90% of motorcycle deaths are observed in developing countries [7]. Motorcyclists who do not wear helmets are three times more likely to be injured in a head accident than those who wear helmets [19].

According to the available data, the effect of helmet use on neck spinal injuries is controversial [8]. For example, Golden Stein studies showed an increased risk of neck injuries in motorcycles due to helmet use [9]. In a cross-sectional study of traffic injuries, Bhatti et al. found that helmets reduced the risk of severe head injury by 1.3 [20]. Khor et al. in a study on the use of helmets in the outcomes of accidents showed that the use of helmets is effective in protecting the spine and head and neck, so that the use of helmets almost increases the risk of severe head injuries by 50% [21]. Kulanthayan et al. in Malaysian road motorcyclists' research found that 49.2% of all road accidents are related to motorcycles. Also, 49.2% of motorcycle casualties were due to head trauma. This study was performed to reduce the mortality rate in motorcyclists by trying to use a helmet properly [19].

In one study, which looked at the barriers to helmet use for 2,970 cyclists in Minnesota, Finnoff cited the most important reasons for not wearing a helmet to be warm weather, thinking that it is unnecessary, annoying, and not having one. In this study, the age group with the highest use of bicycle helmets was those over 59 years old. Finally, it has been concluded that the use of helmets protects the head from trauma [22]. In another study by Sadeghi Bazargani H, the barriers of helmet use in Iranian motorcyclist are similar with Finnof study [23].

This study showed that the number of patients wearing helmets is low (36.2%) and most of the mortality was in a group of patients who did not wear helmets and resulted in head and neck trauma. Lower limb trauma was more common in surviving patients. The present study showed that motorcyclists wearing helmets were less injured and survived more from life-threatening traumas. The study also found more mortality on-road accidents and after rollover, indicating that motorcyclists on roads should be more careful. In terms of the severity of the injury, the use of a helmet reduces the severity of the trauma among the victims.

One of the limitations of the present study is non-cooperation of some participants. Also, some patients were excluded from the study due to being sent to other medical centers

5. Conclusion

Based on the results of the current study, it can be concluded that the use of helmets reduces the severity of trauma and in-hospital mortality of patients. Motorcycle accidents cannot be completely prevented, but head injuries and severity can be reduced by using a helmet. It is suggested that using police force to obligate the use of helmets, with effective training on the importance of using helmets, restricting traffic on roads or creating a special path for two-wheeled vehicles, and speed limits can help for prevention of motorcycle accidents.

Compliance with ethical standards

Acknowledgments

The authors are grateful to all participated in the study, in addition to data collectors, supervisors, and administrative staff of Emergency Medicine, Emam Reza, Hospital, Tabriz University of Medical Sciences, Tabriz, Iran. This article was written based on dataset of Zahra Hajiloo's MD. thesis entitled "The Study of Consequences of Using Helmet On Motorcycle Riders in Tabriz" registered in Tabriz University of Medical Sciences (No. 61066) and was presented in September 2020.

Disclosure of conflict of interest

The author(s) declare that they have no conflict of interest.

Statement of ethical approval

This study has been approved by the Ethics Committee of the Tabriz University of Medical Sciences with the ethics code of IR.TBZMED.REC.1397.691 on 19.11.2018.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study. The informed consent form included the information about the research process and reassuring the patient that his/er personal information remains confidential.

Author's contributions

All authors have read and approved the manuscript. EH, HEB, and FR performed the data collection, literature review, and drafting the manuscript. RME undertook the major parts of the study design and performed the statistical analysis.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available upon request.

Funding/Support

The research and technology vice-chancellor of the university provided financial support for this project in the form of a research grant.

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