ORIGINAL ARTICLE

Cranial and spinal injuries in motorcycle accidents: A hospital-based study

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ABSTRACT

BACKGROUND: Injuries caused by motorcycle accidents have been reported in several studies with an examination from a general trauma point of view. However, to our knowledge, there is no detailed study specific to central nervous system injuries. This research was focused on central nervous system injuries associated with motorcycle accidents.

METHODS: The medical records of 540 patients who were admitted to the emergency department between 2008 and 2016 as the result of a motorcycle accident were retrospectively evaluated. Data were collected from electronic medical records, follow-up forms, and radiological images. Information on patient age, gender, type and site of injury, helmet use, alcohol level, Glasgow Coma Scale score on admission, length of stay in the intensive care unit and hospital, neurological status on discharge, and follow-up was collected and analyzed.

RESULTS: A total of 486 of 540 patients (90%) were male, 54 (10%) were female, and the mean age was 31±18 years (range: 2–85 years, median: 25 years). Cranial injuries were detected in 320 cases (59%). The distribution of cranial injuries was: epidural hemorrhage (12.6%), subdural hemorrhage (15.2%), depressed fracture (10.4%), linear fracture (23%), skull base fracture (5.5%), diffuse axonal injury (9.3%), subarachnoid hemorrhage (25.2%), intracerebral hemorrhage (13.5%), and contusion (26.3%). Spinal fractures were detected in 52 cases (9.6%). Twenty-two (4.07%) of the spinal fractures were observed in the cervical region, 10 (1.85%) in the thoracic region, and 20 (3.7%) in the lumbar region. The mean length of stay in the hospital was 8.2±4 days and 7 days in the intensive care unit. Sixty-eight patients (12.6%) died. Traumatic cranial entities other than linear fracture were associated with an elevated level of mortality. A Glasgow Coma Scale score of 6 or less was associated with significant mortality (68%).

CONCLUSION: A detailed report of motorcycle accident-associated central nervous system injuries is provided. The use of protective equipment, such as helmets, significantly reduced the rate of cerebral injury and death.

Keywords: Accident; head trauma; motorcycle; spine trauma; trauma.

INTRODUCTION

In developing countries, motorcycles are the preferred means of transportation. Because of their low cost, cheap maintenance, and easy handling, their use is increasing. Also, from public point of view, there are several advantages such as decreased traffic crowding and air pollution. Motorcycle accidents are on rise,[1] and are associated with significant health threats. These accidents lead to more severe injuries in comparison to those caused by other vehicles because of differences in protective equipment and mechanisms of injury. Motorcycle drivers are exposed to 20-fold increased risk of injury and death per kilometer.[2] According to National Highway Traffic Safety Administration report, motorcycle drivers have 8-fold increased risk of injury and 35-fold increased risk of death.[3] It was estimated that although motorcycle accidents contribute to 1% of all traffic accidents, they lead to 14% of all deaths.[4] A multinational study has shown that morbidity associated with motorcycle injuries is twice as high in low- and middle-income countries in comparison with that

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in high-income countries,[5] making them an important issue in developing countries.

Most of the studies regarding motorcycle injuries are focused on general aspects of trauma.[6–10] However, there is not much information regarding details of brain and spine injuries. This study aimed to report neurosurgical injuries associated with motorcycle accidents in a large tertiary hospital.

MATERIALS AND METHODS

This study was approved by the Antalya Training and Research Hospital ethics committee (decision dated 08/03/2018 and numbered 5/9). A total of 540 patients who were admitted to Antalya Training and Research Hospital after motorcycle accidents and were consulted by neurosurgical team between November 2008 and December 2016 were retrospectively analyzed using hospital information system (Sarus HBYS) and radiographic imaging system (Sectra PACS). Other motor vehicle and bicycle accident victims were excluded from this study. We collected data regarding age, sex, use of helmet, presence of alcohol, admission Glasgow Coma Score (GCS), trauma characteristics, surgical interventions, length of stay in ICU and hospital, and radiological data. From neurosurgical point of view, brain injuries were classified into following categories: linear fracture, fissure, depressed fracture, skull base fracture, maxillofacial fractures, subarachnoid hemorrhage, epidural hematoma, subdural hematoma, intracerebral hematoma, diffuse axonal injury, and contusion. Spinal injuries were classified according to the location–cervical, thoracic, lumbar; and type of trauma–compression, burst, dislocation.

Statistical analysis was performed by using the SPSS (Statistical Package for Social Sciences) software. The Mann–Whitney U test and chi-square tests were employed for statistical analysis. P value less than 0.05 was considered statistically significant.

RESULTS

Of these 540 cases, 486 were males (90%) and 54 were females (10%). The mean age was 31±18 years (distribution 2–85). The majority of accident victims were males aged 11–20 years (Fig. 1). The majority of accidents took place in June–August (32%), followed by March–May (26%), September–November (24%), and December–February (18%) (Fig. 2). Of all the injuries, 65.2% happened when the driver did not use a helmet; in 28.7% cases, the driver's blood had traces of alcohol. The majority of injuries were head (59%) and musculoskeletal (51%) trauma. The distribution of head injuries according to the type of injury is presented in Table 1. Among the patients presenting with head trauma, 352 had no helmets, and 188 had helmets (p<0.001). GCS on admission varied from 3 to 15, mean was 12±4, median 14. Mean GCS in patients wearing a helmet was 13, and in those without a helmet was 6 (p=0.0007). Head injuries were present in 320 cases (59%).

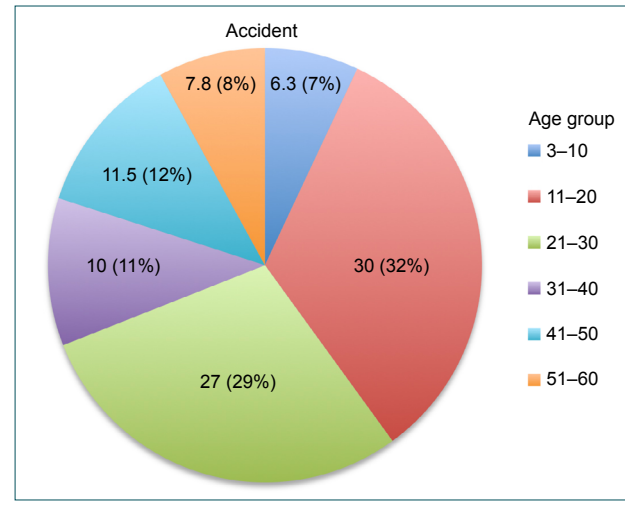

Figure 1. The distribution pattern of motorcycle accidents by age group.

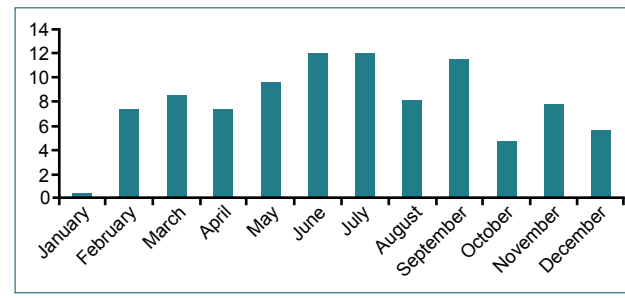

Figure 2. The distribution of motorcycle accidents by month.

The distribution of spine injuries is summarized in Table 2. There was no statistically significant difference regarding cervical spine injuries between patients with and without a helmet (p=0.197). Extremity injuries were present in 102 cases (19%); 65 cases (12%) had both extremity and head injuries; 42 cases (7.7%) had chest injuries; and 14 cases (2.6%) had abdominal injuries. Neither spinal nor extremity injuries were associated with mortality.

The mean hospital stay duration was 8.2±4 days. In patients admitted to ICU, the mean stay was 7 days. In total, 177 (32.7%) patients were operated, and 185 surgeries were performed. There were 50 epidural hematomas, 52 subdural hematomas, 7 intracerebral hematomas, 34 depressed fractures, 2 contusions, 10 cervical spine fractures, 7 thoracic spine fractures, and 15 lumbar spine fracture cases. Out of 306 patients who were initially followed conservatively, 10 were operated (6 subdural hematomas, 2 intracerebral hematomas, 2 epidural hematomas). The total mortality rate was 12.6% (68 patients); men had higher rate (66 out of 486, 14%) than women (2 out of 54, 3.7%), and the difference reached statistical significance (p=0.048). GCS less or equal to 6 was associated with significant mortality (68%). The mortality rate among patients with GCS more than 6 was 1.8%. The statistical difference between the two groups reached the significance level p<0.0001. The mortality rate was 29% in operated group and 1.8% in conser-

Table 1. The distribution of head traumas according to the type of injury

	n	%
Epidural hemorrhage	68	12.6
Subdural hemorrhage	82	15.2
Depressed fracture	56	10.4
Linear fracture	124	23
Skull base fracture	30	5.5
Diffuse axonal injury	50	9.3
Subarachnoid hemorrhage	136	25.2
Intracerebral hemorrhage	73	13.5
Contusion	142	26.3
Maxillofacial injuries	72	13.3
Epidural + subdural hemorrhage	26	4.8
Epidural hemorrhage + linear fracture	20	3.7
Epidural hemorrhage + depressed fracture	32	6
Subdural hemorrhage + linear fracture	10	1.9
Subdural hemorrhage + depressed fracture	26	4.8

Table 2. The distribution of spine injuries

	n	%
Cervical spine fracture	22	4.07
Atlanto-axial	10	
C5	5	
C6	7	
Thoracic spine fracture	10	1.85
T 8	1	
T11	5	
T12	4	
Lumbar spine fracture	20	3.7
L1	13	
L2	7	

vative group, p<0.01. Although extremity, spinal, maxillofacial, and abdominal trauma did not contribute to mortality, the mortality rate was 29% in patients with thoracic trauma and 11% without (p=0.022).

When head injury was present, the mortality rate was 19.4%; and it was 2.7% without head injury (p<0.001). Except for linear fracture, all other traumatic entities were associated with elevated level of mortality: epidural hematoma 26% (p=0.009), subdural hematoma 32% (p<0.0001), depressed fracture 32% (p=0.001), diffuse axonal injury 48% (p<0.0001), subarachnoid hemorrhage 35% (p<0.0001), and cerebral contusion 24% (p=0.0001).

DISCUSSION

The comprehensive management of trauma patients is complex, and it should be performed at specialized centers. Since the vast majority of these patients present with multiple injuries, multidisciplinary approach is absolute prerequisite to maintain the quality of care. The most common mode of transportation in our country is by road. Hence, traffic accidents have become a major cause of injury and death. The number of people riding motorcycle is significant in areas with warm climate, like Antalya. Motorcycle accidents have several specific nuances that distinguish them from the rest of traffic accidents. Since the lack of effective protection like in the car, the bodily injuries tend to be more frequent and severe. Studies have shown that the motorcycle usage is more among young male population.[6,11–14] Thus, accidents affect the most active section of the society, and result in significant public health problem. Numerous papers were published regarding the nervous system injuries in motor vehicle accidents, yet a very small fraction of them was dedicated to motorcycle accidents. Therefore, demonstrating the risk factors contributing to death and permanent injury is of paramount importance. Gorski et al.[6] have found head trauma in 33% of patients and spinal injury in 14% of patients in motocross races, and they reported low overall morbidity but high mortality which was related to the cases requiring surgery. Several studies have shown that head, thorax, and abdominal injuries are major contributors of mortality.[15–17] Similarly, in our study the largest injury group among fatal injuries (12.6%) was thoracic trauma followed by head trauma.

In accordance with the literature reports, our study confirmed that the majority of patients admitted with motorcycle accidents were young males, and the majority of neurosurgical injuries were head traumas (59%). Head trauma is the most important cause of mortality,[18,19] and our study also showed that when present, it significantly affects the mortality (19.4% vs 2.7%, p<0.001). Another important aspect is the presence of intracranial pathology like various forms of hemorrhage, depressed skull fracture, contusion, and diffuse axonal injury. These entities were associated with increased mortality yet linear fracture alone was not. This fact clearly shows that the brain (not head) injury is the most important factor contributing to mortality.

Wearing a helmet has proven to reduce the severity and associated mortality of head injuries.[20–25] Similarly, in our series the rate (352 vs 188, p<0.001) and the severity (mean GCS 13 vs 6, p=0.0007) of head injury was high when helmet was not used. Despite the clarity regarding the protective role of helmet for head injuries, disagreements exist when it comes to cervical spine. The beneficial effect is so negligible that some studies failed to fully demonstrate it. For example, Khor et al.,[26] in their recent large study, observed only 1% decrease in cervical spine injuries in patients wearing a helmet. Some authors even argued that wearing helmet might

actually increase the rate and severity of cervical injuries, yet further studies showed no such effect.[27–29] In our study, there was no statistically significant difference between the helmet-wearers and non-helmet-wearers regarding cervical spine injury (p=0.197). This might be because of type 2 error as the protective effect is too little to be observed in a small cohort. The number of cervical fractures was high in our study, yet the lower thoracic region and upper lumbar region of vertebral column were most frequently affected. This was one of the most important findings of this study because currently there is no effective protection for this area of the spine in motorcycle riders.

Limitations

This study has certain limitations. First, study data reflect admissions at a tertiary hospital. Data from other hospitals were not available. Moreover, these data may show variability in the regions that are socioeconomically and geographically different. Comprehensive investigations taking into consideration data from all hospitals in the same region will be useful in this regard. Another limitation is that the research was retrospectively conducted.

Conclusion

High rate of head and spine injuries has been detected in motorcycle accidents, and detailed distribution of various type of pathologies has been reported. The protective role of helmet wearing has been demonstrated for brain injury but not for cervical spine injuries. Mortality is significantly associated with brain injury (except linear fractures), admission GKS, and presence of thoracic trauma. Evaluation of the patients who presented with motorcycle accident primarily for brain and thoracic trauma is one of the most important factors that increase the probability of survival of patients.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Motosiklet kazalarında kafa ve omurga yaralanmaları: Hastane tabanlı bir çalışma

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AMAÇ: Motosiklet kazalarına bağlı yaralanmalar, genel travma açısından çeşitli çalışmalarda incelenmiştir. Bununla birlikte, merkezi sinir sistemi yaralanmalarına ilişkin ayrıntılı bir çalışma yoktur. Bu çalışma motosiklet kazaları ile ilişkili merkezi sinir sistemi yaralanmalarına odaklanmıştır.
GEREÇ VE YÖNTEM: 2008 ile 2016 yılları arasında motosiklet kazası nedeniyle acil servise başvuran 540 hastanın tıbbi kayıtları geriye dönük olarak değerlendirildi. Veriler elektronik tıbbi kayıtlardan, takip formlarından ve radyolojik görüntülerden elde edildi. Hastaların yaşı, cinsiyeti, yaralanma tipi ve yeri, kask kullanımı, alkol düzeyleri, Glasgow Koma Skorları, yoğun bakım ünitesinde kalış süreleri, taburcu olurken ve takiplerde nörolojik durumları gibi bilgiler toplanmıştır.
BULGULAR: Çalışmaya alınan 540 olgunun 486'sı (%90) erkek, 54'ü (%10) kadın, yaş ortalaması 31±18 (dağılım 2–85, medyan 25) idi. Kraniyal yaralanmalar 320 olguda (%59) saptandı. Kraniyal yaralanmaların dağılımı şöyledir: Epidural kanama (%12.6), subdural hemoraji (%15.2), deprese kırık (%10.4), lineer kırık (%23), kafa tabanı kırığı (%5.5), diffüz aksonal yaralanma (%9.3), subaraknoid kanama (%25.2), intraserebral hemoraji (%13.5), kontüzyon (%26.3). Spinal kırıklar 52 olguda (%9.6) tespit edildi. Servikal bölgede 22 (%4.07) omurga kırığı, torasik bölgede 10 (%1.85) ve lomber bölgede 20 (%3.7) gözlendi. Hastanede kalış süresi yoğun bakımda ortalama 8.2±4 gün, ortalama yedi gündü. Altmış sekiz hasta (%12.6) hayatını kaybetti. Lineer kırık hariç diğer tüm kraniyal yaralanmalar yüksek mortalite ile ilşkiliydi. Ayrıca, 6 veya daha düşük Glasgow Koma Skorları, önemli mortalite (%68) ile ilişkilendirildi.
TARTIŞMA: Motosiklet kazalarının neden olduğu merkezi sinir sistemi yaralanmalarının ayrıntılı bir raporu verilmiştir. Kask gibi koruyucu ekipmanların kullanılması, beyin hasarı ve ölüm oranını önemli ölçüde azaltır.

Anahtar sözcükler: Kafa travması; kaza; motosiklet; spinal travma; travma.

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