



Volume: 2, Issue: 9, 495-497
Sep 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 4.342

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Differential diagnosis of head injuries in automobile accidents and homicides

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Abstract

Introduction: Head injury (HI) is a serious morbid state, resulting from structural changes in the scalp, skull, and/or its contents, produced by mechanical forces. Generally, the most frequent HI cause is road traffic accident (RTA), followed by homicidal and falling from high injuries. The aim of present study is to assess demographic data, causes and patterns responsible for HI among Albanian subjects.

Material and Methods: All HI cases (400) are collected by the Forensic Institute of Albania, based on medical and forensic files of traumatized subjects between years 2012 and 2014. The prospectively-collected and descriptive information is focused on demographic data, responsible factors, type and level of cranial and brain injury, as well as their outcome.

Results: The majority of HI victims were male (84%), and age-wise young adult to middle aged (70%). RTA was the HI cause in 88%, followed by homicides (3.8%), falling from high (3%), etc. With respect to injury mechanisms, extradural hematoma is shown in 93% of cases, followed by cerebral edema (61%), cerebral contusion (37%), skull bone fractures (35%), etc. Severe consciousness' alteration was observed in 57%, while amnesia lasted longer than 4 weeks in 44% of cases.

Conclusion: This survey demonstrates that the HI victims' majority consists of young and middle age males, mostly as a consequence of RTA. The increase of vehicles' use in Albania is more evident than RTA-related HI, indicating that use of newer vehicles, seat belts, air bags, or helmets can decline the potential for a fatal outcome.

Keywords: Differential diagnosis, head injury, injury mechanisms, road traffic accidents

1. Introduction

Head injuries, posing serious consequences, have constantly attracted the attention and interest not only medical but also legal. Compared with all other injuries of the body, they are more frequent and important. It is widely accepted that head injuries causing death, compared to other damages remain in the ratio 1:4. The most frequent HI cause is road traffic accident (RTA), while in homicidal injuries the head is an easy and successful target because skull underlying tissues are comparatively delicate to same degree of skeletal trauma^[1]. The aim of present study is to assess the actual demographic data, causes and patterns responsible for HI in our country.

2. Materials and Methods

All the HI cases (400) were collected by the Forensic Institute of Albania, based on medical and forensic files of traumatized subjects between years 2012 and 2014. The prospectively-collected and descriptive information was focused on demographic data, responsible factors, type and level of cranial and brain injury, as well as their outcome. All data were compiled and structured in a schedule and analyzed with the help of MS excel program.

3. Results and Discussion

The majority of HI victims collected in our study are male (84%), and age-wise young adult to middle aged (70%), with maximum proportion (37%) in 15-25 years of age group followed by 26-35 (20%) and 36-45 (13%) years (Table 1). According to affected subjects or their close relatives, 41% of them were occupied, 44% unoccupied, 13% students, and 2% of them householders.

Table 1: Mechanisms of head injury and their association with sex and age (N = 400)

Age	15-25	26-35	36-45	46-55	56-65	>65	Total
Male/Female	148/28	80/4	52/12	36/8	14/10	6/2	336/64
Radiological Imagery Finding							
Cerebral edema	60	48	24	20	36	28	216
Subdural hematoma	16	12	8	4	8	4	52
Extradural hematoma	138	122	56	24	22	10	372
Cerebellar hemorrhage	10	6	2	3	2	1	24
Cerebral contusion	64	32	20	12	12	8	148
Cranial fracture	52	28	16	16	18	4	134
Intraventricular hemorrhage	2	1	1	1	2	1	8

Majority of HI is caused by RTA (90%), followed by homicide, falling from high and suicide (4%) and still not confirmed 6%. Thirty-one percent of all RTA-victims and 33% of victimized drivers had consumed alcoholic drinks before RTA. Clinic/pathological and radiological examination revealed cerebral edema (61%), subdural hematoma (13%), cerebral contusion (37%), cranial fracture (35%), etc (see Table 1 and Table 2). The HI are also associated with different forms of intracranial hemorrhage, as well as with

different grades of consciousness alteration - moderated Glasgow coma scale (GCS) in 20% and severe GCS in about 57% of subjects (see also Table 1 and Table 2). HI-related amnesia is observed in nearly 97% of collected cases, mostly lasting many days and weeks (see Table 2). In general, a fatal outcome was observed mostly in young and middle aged males as a consequence of RTA (90%), followed by fire arm injuries (4%). The half of these 20 fatalities occurred within 2 hours, especially after hemorrhage-induced HI.

Table 2: Causes and mechanisms of head injury, and their association with consciousness alteration and amnesia (N = 400)

Injury cause	
Falling from height	12
Road traffic accidents	352
Homicide	15
Suicide	8
Electric shock	3
Other	10
Conscience level (GCS)	
Range 3-8	147
Range 9-12	80
Range 13-15	93
Amnesia duration	
No amnesia	13
1-59min	35
1-24h	21
1-7days	62
1-4weeks	94
> 4 weeks	174
Examination Finding– Injury Type	
Superficial skin injury –with/without brain edema, skull bones fracture, intracranial hemorrhage)	
372	
Skull fracture	140
Cerebral edema	244
Cerebral contusion	148
Subdural hematoma	52
Epidural hematoma	28
Cerebellar hemorrhage	24
Ventricular hemorrhage	6

4. Discussion: The most outstanding data which emerges from this survey is that victims' majority consists of young and middle age males. Such type of results is also observed in other countries [2, 4-6]. Thus, Zangoonei *et al.* have reported that male/female overall ratio was 3.4 and the highest male/female ratio was related to motorcyclists [6]. This is probably the mentioned population is more exposed to RTA and other HI causes. Further studies confirm that, apart from RTA, falling from height, blunt weapons or fire arms are important HI inducers [2, 7].

In Albania, the large majority of RTA is caused by personal cars; however and similarly to various surveys [2, 6, 8], heavy vehicles and especially motorcycles are found to be responsible for the majority of RTA-related fatalities. This is because personal cars are largely more frequently used, but a

safely motorcycle's riding is quite more difficult. According to a previous study conducted in the capital of our country (Tirana), HI was observed on 58% of non-fatal RTA, followed by low extremities (34%) [3]. Similarly to this, Zangoonei *et al.* reported that the overall HI ratio to other organ injuries (torso and underbody) was 2.5 and pedestrians had the largest amount of HI (38%) [6]. While the thorax region had the highest incidence of injury in fatal motorcycle-barrier crashes, HI predominates during the fatal motorcycle crashes in all single- and multi-vehicle crash modes [9]. Results show that acute subdural hematoma is more likely to occur in cases of simple fall, assaults and cyclists, while diffuse axonal injury is more typical for vehicular traffic accidents and cases of falling from a considerable height [10].

About one-third of Albanian victims/drivers at the time of HI were under effect of alcoholic drink, which represents a significant risk factor for RTA [8]. It is reported that majority of fatal HI occurs within first 24 h from the RTA [2], while in our study the half of them occurred within 2 hours. According Kanchan *et al.*, the HI were responsible for nearly 3/4th of deaths, and the mean duration of survival following RTA was 6-7 days [4]. These indicate that the importance of RTA as mortality/morbidity cause consists in the increasing number of vehicles, changes in lifestyle and the risk behaviors among general population [2, 4].

Meanwhile, establishment of HI diagnosis consists on forensic neuropathological and radiological examinations, including crystallographic studies of brain liquor obtained after the injury [11-13]. HI mechanisms mostly consisted on fractures, cerebral edema/contusion, and different types of intracranial hemorrhage [1].

Similarly to our survey, the cerebral edema/contusion as well as skull bone fractures are largely more prevalent during HI, whereas various intracranial hemorrhages are associated with an increased risk for fatal outcome [2, 11]. Traumatic acceleration/deceleration injuries are seen to be associated with countercoup or subarachnoid hemorrhages [2, 8, 10]. The most frequent HI mechanism is the hitting a moving vehicle followed by hitting a stationary object, which results in death usually from severe blunt force trauma. This creates internal and external injuries, especially craniocerebral, spinal, and sometimes, with very characteristic injury patterns [8]. Regarding cranial fractures, the mostly of them are shown in skull vault and the linear ones are the commonest, followed by comminuted, depressed and ring fractures [2]. Different studies suggest that the commonest fracture-affected bones are parietal and temporal ones, followed by frontal and occipital bone [2, 8, 14]. The combination of HI-related fracture and hemorrhage in cases of instantaneously-died victims demonstrated that crash injury was responsible for severe brain damage and expulsion of grey matter [2]. HI can be also caused by domestic violence, usually located in the head, face, and neck areas. According Curca *et al.*, severe lesions were found in less than 10%, but sexual aggression was absent in such cases [14].

Recent findings suggest that experimental traumatic brain injury in sheep induces a short hypertensive response, followed by a significant and prolonged systemic hypotension. Increased intracranial pressure combined with systemic hypotension can lead to the reduction of cerebral perfusion pressure and brain oxygenation, which provides a potential pathophysiological explanation for immediate clinical manifestations in humans following significant traumatic brain injury [15]. Similarly to our results, the traumatic HI is associated with consciousness alteration in the majority of cases, predominantly with a low GCS score [2]. This could be associated with presence of amnesia, which lasts mostly many days and weeks. However, loss of consciousness and amnesia can be induced even after mild HI, and in these cases, radiological examinations could be helpful when physical examination results as false normal [16]. A longer post-traumatic amnesia can be associated with reduction of life quality, cognitive performance and functional outcome [17-19]. In addition, the emotion recognition test could be the only measure that is significantly related to post-traumatic amnesia duration, GCS score, and the presence of prefrontal lesions [20]. Despite the fact that radiological abnormalities correlate with consciousness alteration, a presence of vomiting, loss of consciousness or amnesia may

be a predictor of abnormal computerized tomography even in patients with normal GCS score [21, 22].

5. Conclusions

Was demonstrated that the HI victims' majority consists of young and middle age males, mostly as a consequence of RTA. The age-profile seems to be in a status quo, because a previous study (conducted in our country 15 years ago) demonstrated that non-fatal RTA-related victims represent the same age dispersion [3]. Even if there is an increase of RTA-related HI in our country (130 vs. 200 cases/year), it should be mentioned that use of vehicles in our country is multiplied during this period of time. This indicates that use of newer vehicles, seat belts, air bags, or helmets can decline the potential for a fatal outcome [2, 23-25]. Moreover, a stricter enforcement of traffic laws, strengthening of emergency healthcare as well as improving of road capacities and traffic signalization could play a synergistic role [4-6]. On the other hand, a strict arm control and the improving of social level may decline fatalities during personal rivalries and family quarrels [2, 14, 26]. The presence of fractures, cerebral damage, and especially intracranial hemorrhage could be a risk factor for fatal outcome especially during first hours; therefore, an immediate intensive and qualified first aid can be lifesaving [5]. This is very important as long as the half of victims died on the spot or in the way to hospital without getting any medical support [2].

6. References

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