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Severe traumatic brain injury (TBI) – a seven-year comparative study in a Department of Forensic Medicine

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Abstract

Deaths caused by traumatic brain injury (TBI) increase in incidence every year worldwidely, mainly in developing countries. Thus, *World Health Organization* (WHO) estimates that in 2020, TBI will become the third main cause of death. In our study, we evaluated the deaths caused by TBI recorded within the Institute of Forensic Medicine of Craiova, Romania, between 2011 and 2017. Therefore, according to age, the cases were divided into two groups: people aged 0–18 years old (including 18 years old) and people aged over 18 years old (a total of 1005 cases, of which 971 were adults and 34 included in the age group 0–18 years old). In both groups, most patients were males from the rural area. In adults, falling was the main legal entity of the cases, followed by car accidents (which were the most common in children). In both groups, in car accidents, most of them were pedestrians and car occupants. Various aggressions (human, animal, self-injury) were found in 94 (9.68%) of the adult cases and in four (11.76%) cases of children. Another parameter under study was the blood alcohol concentration, being observed that most of the subjects with positive blood alcohol content died from car accidents. By evaluating the Glasgow Coma Scale (GCS) score as a prognostic factor, most of the subjects presented third and fourth degree coma at admission; still, 5.14% of the adult patients who deceased had GCS score 15 at admission, death occurring probably by developing some intracranial hematomas in time. Regarding the morphology of the lesions, most patients presented various forms of cranial fractures, 185 (19.05%) adults in association with extradural hemorrhages/hematomas, but also there were four cases with extradural hematomas without any cranial fractures. In children, there was highlighted a single case of extradural hemorrhage under the fracture line. Seventy-eight percent of the adults and 44.12% of children presented subdural hematomas associated with other meningo-cerebral lesions. Also, 83.63% of the adults and 97% of children presented brain contusions. In both groups, brain laceration was observed in approximately 50% of the cases.

***Keywords*:** traumatic brain injury, mortality, mechanical forces, road traffic accidents, falls, violence.

Introduction

Traumatic brain injury (TBI) represents one of the main causes of morbidity, mortality and disability, all over the world. It is estimated that worldwidely, every year, between 50 and 74 million people, of all ages, suffer a TBI [1, 2]. In the last decades, the TBI incidence continued to grow in almost all the countries of the world. Only in USA there are recorded about 2.5 million TBIs every year, thus costing the American healthcare system approximately 76.5 billion dollars [3, 4]. Also, in USA, TBIs are responsible for about 50 000 deaths every year [5, 6]. Based on some estimations of the *World Health Organization* (WHO), TBI will become the third main cause of death and disability until 2020 [7, 8].

TBIs are caused by direct traumas on the head that cause neuronal lesions or dysfunctions. These are caused most often by falling from various heights, motorcar accidents, sports accidents, human or animal aggressions [9–14]. These mechanical forces vary in intensity and action mechanism, thus causing various lesions of the brain. Generally, TBIs are classified as mild, moderate or severe forms [15, 16].

The patients that survive after TBI frequently present minor or severe disabilities, manifested by cognitive, motor or emotional deficiencies, with an impact on the patient's life quality, and also on the patient's family and society [17, 18]. According to some studies, in 2005, in USA, there were about 3.17 million people (approximately 1.1% of the population), who presented complications or disabilities following TBI, manifested through various neurological and psychological diseases [19, 20].

The incidence and occurring mechanisms of TBI vary from one geographical area to another and even from one country to another. Also, the causes leading to TBI vary a lot according to the age of exposed persons: if in persons aged less than 14 years old, the main cause of

TBI is represented by falling from various heights, in teenagers and adult persons, the main cause of TBI is represented by car accidents [21–23].

Aim

In our study, we evaluated the deaths caused by TBIs investigated in a Department of Forensic Medicine in Romania – the Institute of Forensic Medicine of Craiova –, over a period of seven years, both in the adult population and in the under-aged people (0–18 years old).

Materials and Methods

Our study is a retrospective one, analyzing all the deaths caused by TBIs occurring in adults and children, between January 1, 2011–December 31, 2017, diagnosed within the Institute of Forensic Medicine of Craiova. The analyzed data were extracted from the forensic reports on corpses performed by the forensic doctors in the above-mentioned period, as well as from the results of the complementary investigations required during autopsies (histopathological and toxicological ones). Other data were extracted from the general clinical observation sheets in various Clinics and Hospitals, especially in the Emergency County Hospital of Craiova, where there was admitted an important number of TBI patients, right after the TBI occurrence or shortly after; also, some data were taken from the emergency medical records performed by the doctors within the Emergency Department (ED) of the above-mentioned Hospital (for the cases that arrived here and deceased), as well as from the investigation records performed by the criminal investigation officers at site.

In order to perform the study, the data obtained from these medical and forensic records were introduced into Excel sheets, for a subsequent statistical processing. There were performed charts showing the main characteristics of the TBI patients; also, in our study we used macroscopic images performed during forensic autopsies within the Institute of Forensic Medicine of Craiova on deceased persons due to TBIs.

The extracted data regarding death cases caused by TBI were divided into two large groups: a group of adults and a group of children and teenagers (aged 0–18 years old), mainly studying the comparative elements between the two groups. We mention the fact that the study was performed after the previous approval of the management of the Institute of Forensic Medicine of Craiova, also being respected the measures for keeping the confidentiality and protection of personal data, according to present laws.

Results

Within the Institute of Forensic Medicine of Craiova, between January 1, 2011–December 31, 2017, there was performed a number of 4626 forensic autopsies under the circumstance of violent death or suspicion of violent death; after the autopsies, there was established that during this period the number of violent deaths was 2924, representing 63.2% of the total of deaths, the rest of 1702 (36.8%) cases being non-violent deaths. In the seven years under study, the number of violent deaths varied between 385 and 460, the mean value of violent deaths being 417/year (Figure 1).

Of the violent deaths, the ones caused by TBI were 1005, of which 34 (3.38%) deaths occurred in children and 971 (96.62%) deaths occurred in adults (Figure 2).

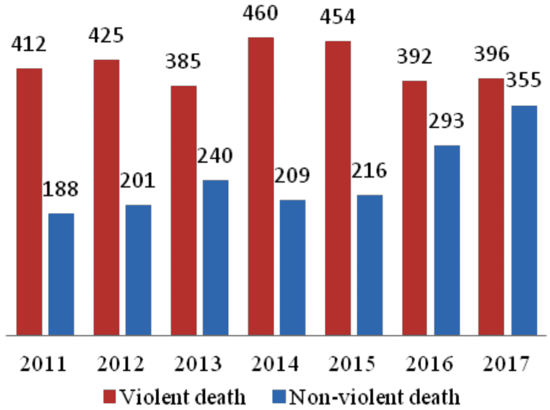

Figure 1 – *Distribution of violent and non-violent deaths within the Institute of Forensic Medicine of Craiova, Romania, between 2011 and 2017.*

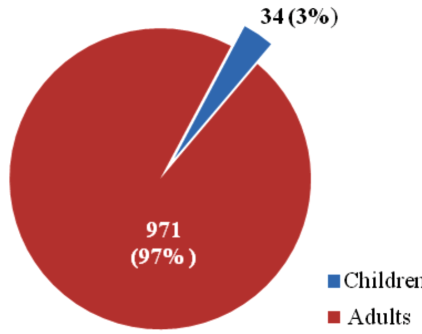

Figure 2 – *Distribution of deaths on the two age groups under study.*

Regarding the gender distribution of TBI deaths in adults, we observed that of 971 cases, 765 (78.78%) were males and only 206 (21.22%) were females. In children, the situation was similar, in that out of the 34 deaths by TBI, 26 (76.47%) were males and eight (23.53%) deaths were females (Figure 3).

Studying the death distribution according to the social environment, in adults, 627 (64.37%) persons were from the rural area, while 344 (35.43%) were from the urban area; in children, 20 (58.82%) cases were from the rural area and 14 (41.18%) cases were from the urban area (Figure 4).

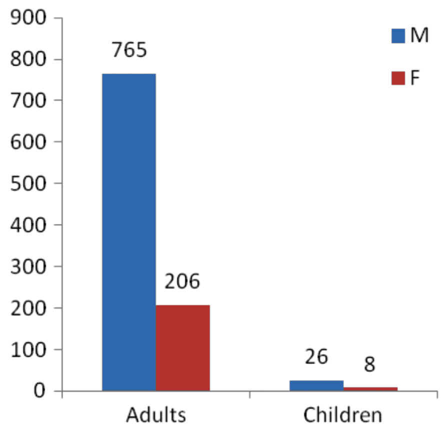

Figure 3 – *Distribution of violent deaths according to gender.*

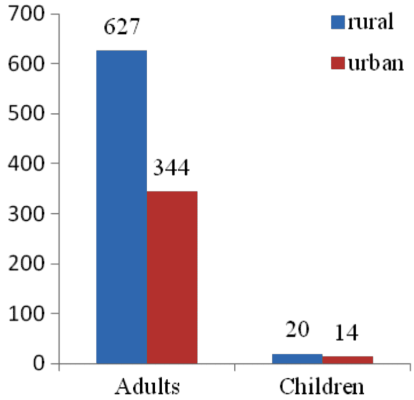

Figure 4 – *Distribution of deaths according to the social environment.*

Regarding the legal framing, an important percentage of the cases, both in adults and children, was the prerogative of car accidents. Therefore, in the adult persons, of the total number of 971 deaths, 307 (31.61%) were caused by car accidents. Of these, the pedestrians were the most affected, the number of deaths caused by car accidents involving pedestrians being 118, representing 12.15% of the total of violent deaths in adults, namely 38.45% of car accidents. The occupants of the cars (drivers and passengers) totalized a number of 84 deaths, representing 8.65% of the deaths by TBI in adults, namely 27.36% of car accidents. Also, 62 deaths, representing 6.38% of the deaths by TBI or 20.19% of car accidents, were recorded in bikers; 22 representing 2.26% of the deaths by TBI in adults and 7.16% of car accidents were recorded as a result of car accidents with victims occupying animal-tracting vehicles, while 21 cases of violent deaths, representing 2.16% of TBI deaths in adults and 6.68% of car accidents resulted in the drivers of other types of vehicles (motorcycles, mopeds) (Figures 5 and 6).

In children, of the total number of 34 deaths, 26 (76.47%) were due to car accidents. Of these, 16 cases, representing 47.06% of the total deaths in children, involved pedestrians; eight (23.53%) cases were represented by children present in a car at the impact moment, while two (5.88%) teenagers were injured driving a moped.

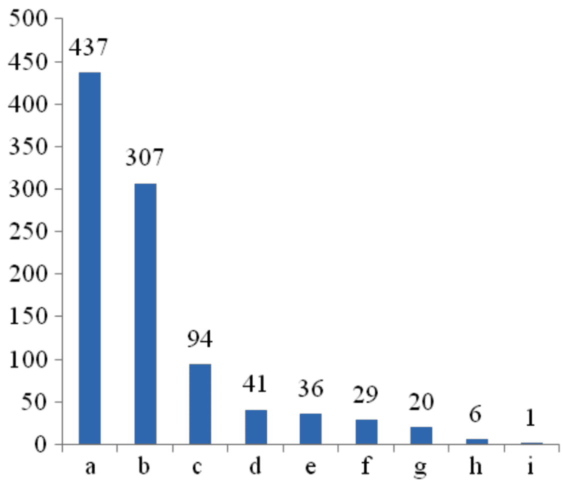

Figure 5 – *Distribution of deaths in adults according to the legal framing. a: Fallings; b: Car accidents; c: Aggressions; d: Various accidents; e: Non-legal framing after autopsy, f: Fallings from height; g: Train accidents; h: Work accidents; i: Airplane accident.*

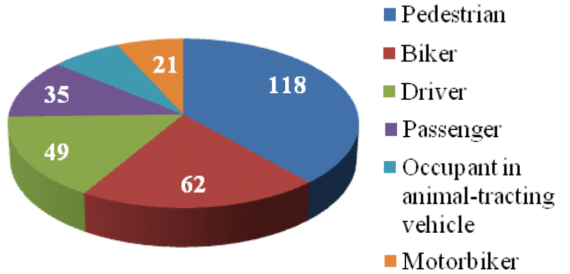

Figure 6 – *Distribution of deaths in adults according to the type of traffic accident.*

Another mechanism of violent death was the one by falling, a mechanism that affected especially the elderly. In adults, the number of deceased persons by falling was 437 (the most significant number in our statistics regarding the legal frame), representing 45% of the total of TBI deaths, thus exceeding the deaths caused by car accidents. In children, there was recorded only one case of death caused by falling (out of bed).

Other violent deaths by TBI were represented by aggressions (human, animal or self-injuries). In adults, 94 persons (9.68% of the total of deaths) were victims of aggressions: 80 (8.23%) individuals deceased because of human aggressions; nine individuals (0.92% of TBI deaths) died because of animal aggression, while five deceased due to self-injuries (0.51% of the deaths).

In children, three (8.82%) cases suffered lesions because of animal aggressions and only one child (3%) was recorded as a death caused by human aggression. Also, in children, there were recorded two deaths because of the fall of blunt bodies on the head (a television and a tree branch, respectively) and a death caused by a train accident (Figure 7).

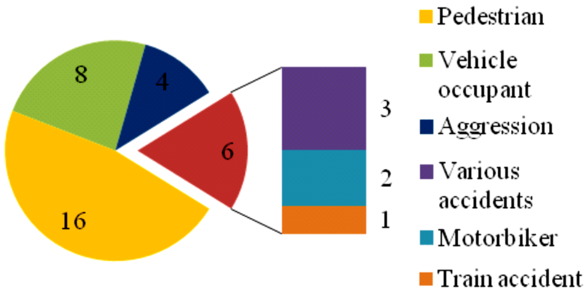

Figure 7 – *Distribution of deaths in children according to the legal framing.*

Another parameter studied was the blood alcohol content. Blood samples were taken for alcohol determination in 355 (36.56%) adult cases. In nine cases (2.54% of the cases where blood alcohol content was found), most of them occurring in car accidents, we observed very high blood alcohol level over 2.5 g‰. A blood alcohol content between 1.5–2.5 g‰ was found in 34 cases (9.57% of the cases where blood was taken for establishing the alcohol content), of which 19 cases of car accidents, four cases of fallings and four cases of human aggressions; within the values of blood alcohol 0.5–1.5 g‰, there were recorded 57 (16.05%) cases, of which 31 cases of car accidents and 13 fallings; positive blood alcohol content less than 0.5 g‰ were found in 29 cases (8.16% of the 355 cases), of which 13 car accidents, seven fallings and five human aggressions. In 226 cases (63.66% of the adults where there was taken blood for alcohol content) presented negative toxicological tests for blood alcohol. In three cases of children and teenagers, there were observed a positive blood alcohol content (less than 0.5 g‰) in two cases of car accidents: pedestrians and an 11-year-old girl, victim of a human aggression with blunt object and a stabbing-cutting object (knife).

The Glasgow Coma Scale (GCS) score was recorded in the medical documents of 629 (64.77%) adults, namely in 20 (58.82%) children of the admitted patients. Studying the value of the GCS score at admission, in adults, we observed that 172 patients presented fourth degree coma (27.34% of the cases where the GCS score was recorded), 171 (27.19%) patients presented third degree coma, 124 (19.71%) patients second and first degree coma (GCS score 6–8), 128 (20.35%) patients presented altered consciousness (GCS score 9–14), and 34 (5.41%) patients presented preserved consciousness (GCS score 15).

Of the children where there was recorded the GCS score at admission, 17 (85% of the cases with a recorded GCS score at admission) presented profound coma with GCS score 3, while three children presented third degree coma (15% of children). In the other 14 deaths recorded in children, there could not be established the GCS score.

Studying the morphology of injuries, 706 (72.7%) adult persons and 27 (79.41%) children presented various forms of skull fractures, showing a high intensity of the impact. Of these, 600 (84.98%) of the total patients with skull fractures presented fractures of the vault and base; in 93 (13.17%) cases, there were found single vault fractures, without irradiation to the skull base, and 13 (1.84%) cases presented isolated fractures of skull base (Figures 8 and 9).

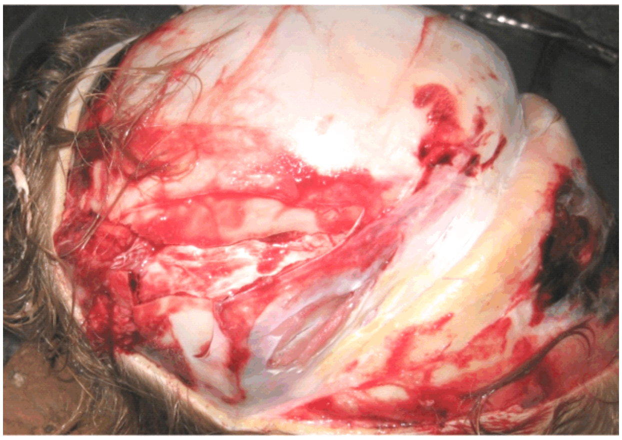

Figure 8 – ***Comminuted fracture of the vault with intrusive fragments localized at impact area (3-year-old girl, car accident).***

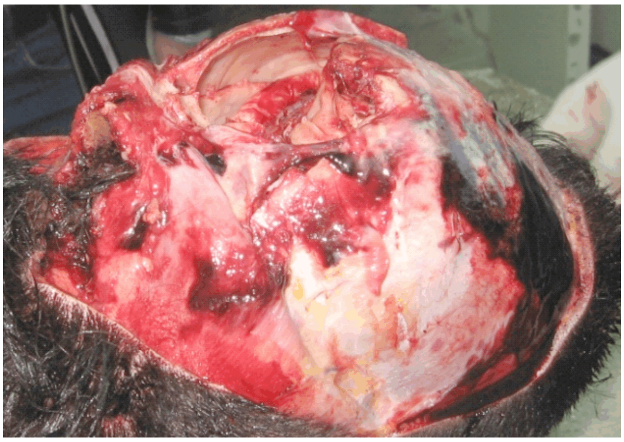

Figure 9 – ***Comminuted skull fracture with detachment of bone esquillae and effraction of brain matter in the exit orifice (21-year-old male, suicide by shooting).***

TBIs also caused lesions of the meningo-cerebral vessels, which manifested through various types of hemorrhages. Thus, hemorrhages/hematomas in the extra-dural space were found in 189 (19.46%) adults. The correlation of skull fractures with extradural hemorrhages in adults showed that 185 cases (19.05% of adults) presented extradural hemorrhages/hematomas occurring in the fracture foci, but there were also four (0.41%) cases where there were observed extradural hemorrhages with no skull fracture (Figures 10 and 11).

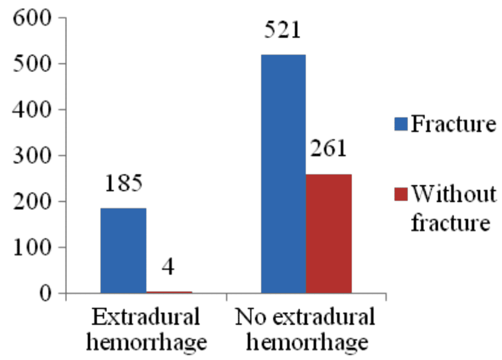

Figure 10 – ***Report of extradural hemorrhage/hematoma on cranial fracture in adults.***

In a single case of a child, there was highlighted an extradural hemorrhage under the fracture line; in the other cases of children diagnosed with skull fracture, there were not highlighted any extradural hemorrhages, an aspect that can be explained by a high adherence of the dura mater on the endocranium in children.

Regarding the subdural hemorrhages and hematomas, in the group of adults, they were present in 758 cases (78% of the total of studied cases); in 150 (15.45%) cases, subdural hemorrhages were associated with extradural hemorrhages. Regarding the clinical forms of subdural hematomas in adults, 354 (46.7%) cases presented acute forms, with a survival period less than three days; 332 (43.8%) cases presented subacute forms, with a survival period of 3–15 days and 72 (9.5%) cases were chronic forms, with a survival period more than 15 days (Figures 12 and 13).

In children, we found 15 cases (44.12% of deaths) of subdural hemorrhages/hematomas; six (17.65%) cases presented acute forms, while nine (26.47%) cases presented subacute forms.

Leptomeningeal hemorrhages highlighted during autopsy, either diffuse or localized, were present in 928 (95.57%) adults and in 33 (97%) children, most often in association with other meningo-cerebral injuries (Figures 14 and 15).

Regarding brain contusions, they were observed during autopsies and confirmed pathologically in 812 (83.63%) adults, of which 341 (42%) dead persons presented contusions in the cerebral trunk. Of the persons with brain contusions localized in the cerebral trunk, 233 cases arrived to the ED or they were admitted to Hospital, persons in whose medical records there was also recorded the GCS score. Thus, of the patients with brain contusions localized in the cerebral trunk, 85 (10.46%) presented profound coma, 78 (9.6%) patients presented third degree coma, 34 (4.18%) second and superficial coma, and a number of 36 (4.43%) patients presented a preserved or slightly altered consciousness (GCS score >8) (Figures 16 and 17).

In children and teenagers, 33 (97%) dead persons presented brain contusions, of which 16 (47%) with a localization in the cerebral trunk.

Post-traumatic parenchymatous hematomas in the contusive foci were highlighted in 126 (12.97%) adults and in a single child (Figure 18).

Brain laceration was diagnosed in 493 adults and 17 children (approximately 50% of the deceased), mainly found with severe TBIs (Figure 19).

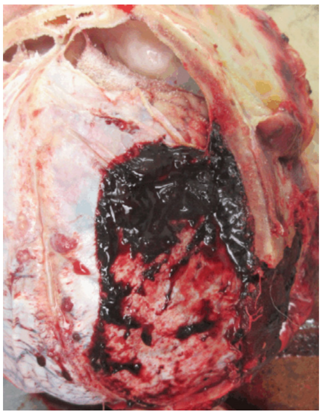

Figure 11 – ***Extradural hematoma with typical localization in the Gerard-Marchand space (57-year-old male, falling).***

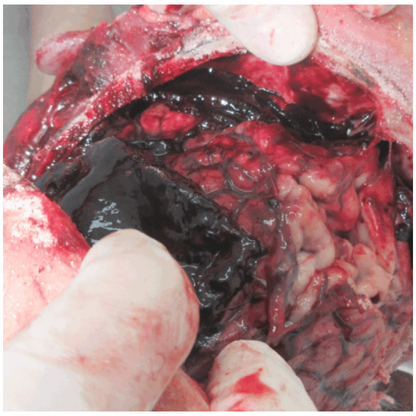

Figure 12 – ***Subacute subdural hematoma after four days of survival (70-year-old male, falling).***

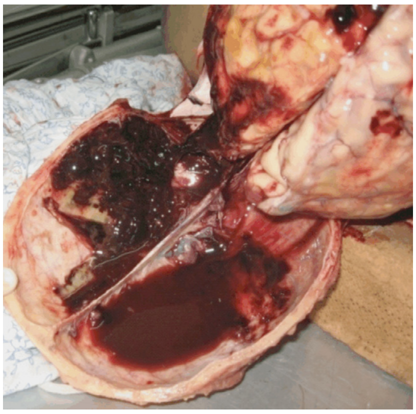

Figure 13 – ***Chronic subdural hematoma after a survival period of 22 days (84-year-old male, falling).***

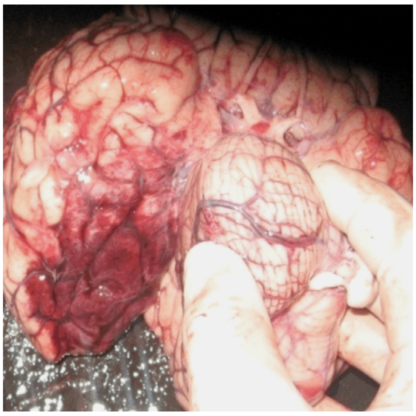

Figure 14 – ***Localized leptomeningeal hemorrhage (51-year-old male, car accident).***

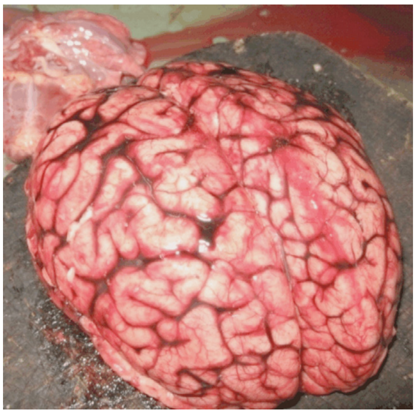

Figure 15 – ***Diffuse leptomeningeal hemorrhage "in the canvas" (3-year-old boy, car accident).***

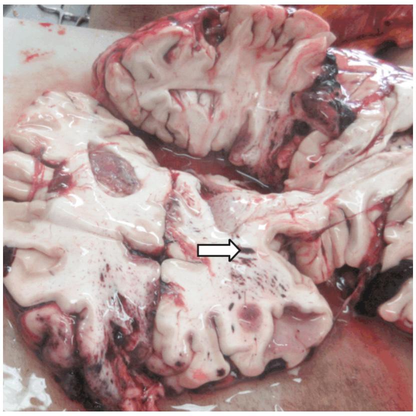

Figure 16 – ***Cortical and subcortical brain contusions: Pitres section (52-year-old male, car accident).***

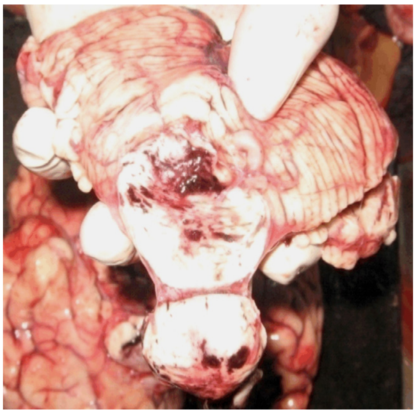

Figure 17 – ***Severe brain contusions localized in the cerebral trunk (50-year-old male, falling from height).***

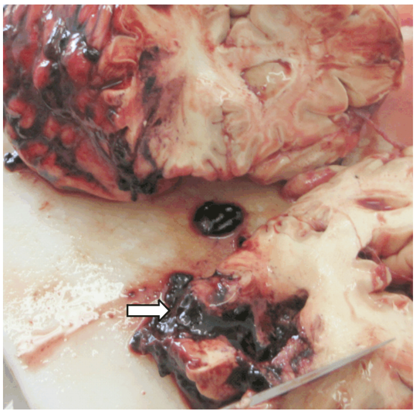

Figure 18 – ***Intraparenchymatous hematoma developed in the contusion foci with effraction in the subdural space (66-year-old male, falling).***

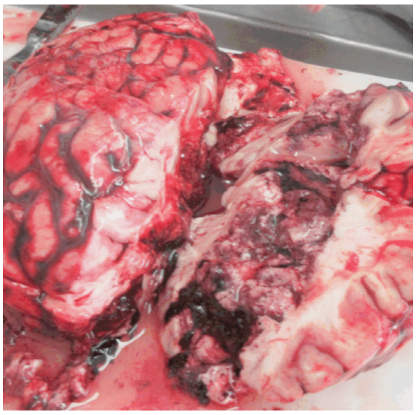

Figure 19 – ***Massive brain laceration, transfixiant wound of the head (31-year-old male, suicide by shooting).***

Discussions

TBI represents a major health problem worldwidely, with an incidence of about 100–600/100 000 inhabitants and a mortality rate for severe TBI of about 20–50% in developed countries and up to 90% in other countries [24, 25]. It is estimated that every year, only in the USA die approximately 52 000 persons due to TBIs [26]. The annual incidence of TBI is estimated to 50 million cases all over the world. Also, it is considered that approximately half of the planet's individuals will suffer a TBI during their lifetime [26, 27].

TBI represents a major problem for victims, families and community, because even a minor TBI may lead to the onset of a disability for life, with very high medical and social expenses. The total lifetime expenses in patients with moderate and severe TBIs were estimated to 8.6 billion dollars in 2008 in Australia [28] and to 60 billion dollars in 2000, in USA [29]. Other studies showed that every year TBIs cost the global economy approximately 400 billion USA dollars, representing 0.5% of the worldwide total income [26, 27], while 60% of the patients with severe TBIs either die or remain with at least one severe permanent disability, thus requiring high social costs, sometimes becoming socially dependent.

In the European Union (EU), there is estimated that, every year, over a million people are admitted to hospital with a moderate or severe TBI, which makes TBI one of the major causes of morbidity and mortality in EU [3, 30, 31]. Systematic epidemiological studies showed that in EU there live over 7.7 million people with disabilities caused by a TBI [31].

In order to understand the severity of the brain lesions caused by TBIs, we should mention that, besides the primary lesions resulted by the mechanical forces applied on the skull at the trauma moment, there also appear secondary lesions, which represent a cascade of biochemical and molecular changes induced by the TBI. These imply the onset of the oxidative stress, the accumulation of reactive oxygen species, the increase of excitotoxicity of the excessive glutamate, the triggering of some neuro-inflammatory local processes, process causing mitochondrial dysfunctions at a neuronal and glial level, local ischemia, cerebral edema, etc., having as the final result the neuronal cell death [32–36]. Therefore, the persons with severe and moderate TBIs are considered major emergencies, which require a complex treatment and a careful monitoring during a large period of time, as a TBI is produced in seconds or milliseconds, whereas the biological consequences may last for a lifetime [37].

In our study, within the Institute of Forensic Medicine of Craiova, we analyzed the deaths caused by TBIs over a period of seven years. Our study proved that TBI is a pathology found from the newborn to the elderly, but most (97%) of the deaths by TBI occurred in adult persons (over 18 years old).

Most of the studies approaching TBI showed that this pathology is found in all people, all ethnic groups and all ages [2]. In USA, the age of patients is closely related to the TBI incidence. Thus, children aged between 0 and 4 years old, teenagers aged between 15 and 19 years old and adults aged over 65 years old, are among the most susceptible to be affected by a TBI. Post-traumatic hospitalization and death are more frequent in the adults aged over 75 years old, which suggests that the age at injury time represents a risk factor as far as an immediate or long-term recovery is concerned [37].

Although the percentage of deaths in children was quite low (3%) in our study, it should be proven that TBIs in children are quite frequent, but have various intensities and only a relatively low percentage of severe TBIs result in death. Similar data have been also highlighted by the studies performed by *American Centers for Disease Prevention and Control* regarding pediatric TBI, showing that approximately 475 000 children aged between 0–14 years old undergo a TBI every year, of which up to 90% are the ones with mild lesions that go back home, 37 000 are hospitalized and 2685 die because of the injuries. The annual rate of mortality caused by the TBIs in children younger than 4 years old was 5 to 100 000 inhabitants [38]. Although a relatively small number of children die by TBI, there are studies showing that a TBI during childhood may have negative effects on the child's development, the child being prone to develop cognitive, behavioral or emotional deficiencies, even at an adult age [39–41].

Regarding the gender of the deceased persons because of a TBI, in our study, we observed that males represented more than 3/4 of violent deaths by TBI, both in children and in adults. Similar data were also reported by Majdan *et al.* (2016), who showed that in 2012 in the 25 EU countries and Turkey there were recorded 33 415 deaths caused by a TBI, of which 22 886 (68%) were males [42]. Most deaths were recorded in people aged over 65 years old [42]. Another study, performed in Norway, showed that severe TBIs occurred in a higher number in men than in women, in all age groups, while the number of deaths was higher in the elderly [43]. Similar data regarding severe TBIs and mortality according to gender were also displayed by other studies from Europe, Asia or America [11, 21, 44, 45]. We consider that these differences related to gender are due to the fact that men are more involved in economical activities, consume more alcohol, drive more often; also, we consider that deaths by TBI are more numerous in the elderly due to a co-existence of other comorbidities that affect the balance, alter attention, work capacity or reason.

Another particular aspect of our study was the distribution of TBI deaths as violent according to the social environment. We observed that about 2/3 of deaths by TBI, both in adults and in children, were recorded in the rural area. This aspect may be due to the medical healthcare system that does not provide a rapid access for the patients in the rural areas to specialized medical services, namely to ED, intensive care unit (ICU), neurology or brain surgery.

The analysis or "legal framing" in our study showed that most deaths were caused by fallings from various heights (48%), followed by car accidents (about 33%). Our data are in accordance with the results of other studies highlighting that the first causes of violent death are fallings and car accidents [26, 46–50].

Another factor involved in the etiopathogeny of violent deaths by TBI is alcohol intake. In our study, 38.87% of deceased persons by a TBI, in whom there could be established the blood alcohol content, had consumed alcohol before the traumatic event. This risk factor contributed to the mechanism that led to their death, such as: traffic accidents, fallings, human aggressions, etc. Numerous studies showed that alcohol is a major risk factor in the onset of TBI and violent deaths, in a high percentage (30–50%) [49–53]. Posti *et al.* (2019) showed that in Finland the reduction of alcohol intake with 1.2% every year was accompanied by the decrease of severe TBI by approximately 4.3% in men and by 2.4% in women [54].

The evaluation of the severity of brain lesions according to the GCS score in our study could be performed only in the cases where the patient preserved his vital functions and came to the ED. Of the 1005 individuals deceased after a TBI, the GCS score was performed on 649 (64.58%) of the patients (adults and children); of these, 363 (56%) presented third or fourth degree coma, with very low values of GCS score and died in the immediate days following the trauma. Still, there should be observed that even though 128 patients presented altered consciousness (GCS score 9–14), while 34 patients presented a preserved conscious state (GCS score 15), they subsequently deceased, which shows that GCS is not a clear prognosis indicator.

GCS is an instrument of neurological evaluation intensely used in classifying brain lesions, especially in the acute stage of the lesions: the lower the GCS score, the more intense the brain lesions are [55]. Still, the patients over 65 years old had a poorer progress, regardless of the nature of the traumatic injury or GCS score at hospital admission, due to the cerebral changes related to age and some comorbidities [56, 57]. Due to these reasons, numerous studies considered that old age represents an important risk factor in TBIs [58–61].

The morphological study of the brain performed during the necropsy examination showed the presence of complex lesions in all cases, starting from lesions of the skull, vascular lesions (diffuse meningeal hemorrhages, extradural, subdural, intracerebral hematomas), associated with lacerations of cerebral matter or diffuse parenchymatous lesions.

We are convinced that to the macroscopic lesions there were added other microscopic ones that finally led to the death of the injured person.

Conclusions

In the Institute of Forensic Medicine of Craiova, there were recorded 1005 deaths by TBI between 2011 and 2017 (971 cases in adults and 34 cases in individuals aged 0–18 years old). In both groups, the majority were males from the rural area. Most cases in adults were caused by fallings – 437 (45% of the violent deaths due to TBI), followed by car accidents – 307 (31.61%) cases. In children, 26 (76.47%) cases were the result of car accidents, with only one case of falling. Because of human aggressions, there were recorded 80 (8.23%) cases in adults and one (3%) case of death in children. Most positive blood alcohol contents found in the adult group were the result of car accidents, followed by fallings, an aspect also found in the group of children (two cases of car accidents). Of the patients with a recorded GCS score at admission, a high number of adults presented third and fourth degree comas at admission (343 cases, representing 54.53%) but there were also 34 (5.41%) cases of deaths who presented a preserved conscious state at admission (GCS score 15). In children, all the patients presented third and fourth degree comas at admission. In both groups, most of the patients presented cranial fractures, namely 706 adults and 27 under-aged individuals. Of the adult patients with cranial fracture, 185 presented extradural hemorrhages/ hematomas under the fracture line, but there were also four cases of extradural hemorrhages in the absence of cranial fracture. In children, there was found a single case of extradural hemorrhage below the fracture (high adherence of dura mater in children). Seventy-eight percent of the adult patients presented subdural hemorrhages/ hematomas, most of them (90.5%) acute and subacute forms. The 15 subdural hematomas found in children were also acute and subacute forms. Most patients presented brain contusions, of which an important percentage with localization in the cerebral trunk. Also, in 126 (12.97%) cases of adults and one case of a child, the necropsy examination highlighted the presence of intra-parenchymatous hematomas in the contusion foci. In approximately 50% of deaths by TBI, there were recorded brain lacerations.

Conflict of interests

The authors declare that they have no conflict of interests.

Authors' contribution

Răzvan Ştefan Ţolescu & Marian Valentin Zorilă have contributed equally to this paper.

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